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Calculation of fishing power on vessels for which data were submitted to Effort Working Group Pilot Study

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Introduction

As part of the pilot study undertaken by the Working Group on Fishing Effort Studies (ICNAF, 1974) relative fishing power coefficients of the vessels included in the 1801+GRT data of FRG, Poland and Japan were calculated separately. The data used in each such calculation were also used in calculating the ratio of average catch per unit effort (CPUE) values, in order to assess the stability of each set of data for each country. Regardless of which vessel was used as the "standard" fishing power coefficients (from the smallest to the largest) were found to vary considerably. Moreover, the ordering of the vessels (i.e. largest to smallest fishing power coefficient), varied depending on which vessel of a country was used as the "standard". In comparing the fishing power coefficients with the ratios of mean catch per effort, using the same data as in the calculation of fishing power coefficient in each case, it appears that in only a few cases were the two statistics the same, with the former usually being greater than the latter.

Data base

The Effort Working Group requested data from each country to be used in their study. The request was for daily records of catch, hours fished and position of two years (1971 and 1972, if possible, for March, April, September and October) of 20 vessels of tonnage class 0-50 GRT or 1801+GRT, fishing in ICNAF Subdivisions 5Ze and SA 6. Data of vessels of the 1801+GRT class from Poland (1971-1972), Japan (1971-1972), and the Federal Republic of Germany (1972-1973) were submitted for analysis.

Data were submitted from FRG for 10 vessels in 1972 and for 13 vessels in 1973; from Poland, 12 vessels in 1971, 10 vessels in 1970; from Japan, 15 vessels in 1971, 12 vessels in 1972.

Analysis of data

The data from each country was sorted into "area-date" blocks. An "area-date" block is a block of data containing catch and effort data for all vessels from one country that fished in the same area on the same day. Area is equal to one 60-minute square area. Day is equal to one 24-hour period. Over all blocks the coefficients of relative fishing power were calculated as follows (Tables 1-3):

$$(1) \quad \text{RFP (vessel } x) = 1/_n \sum_{i=1}^{n} \frac{\text{CPUE (vessel } x)\ i}{\text{CPUE (vessel } y)\ i}$$

$$(2) \quad \frac{\text{Mean CPUE } (x)}{\text{Mean CPUE } (y)} = \frac{\sum_{i=1}^{n} \text{CPUE (vessel } x)\ i}{\sum_{i=1}^{n} \text{CPUE (vessel } y)\ i}$$

n = total number of times vessel x and vessel y appear simultaneously in an "area-date" block

vessel y = reference vessel; each vessel is used interchangeably as the reference vessel

CPUE = metric tons of fish caught per hour of fishing

Equation 1 gives a measure of fishing power of vessel x relative to vessel y according to the definition of fishing power. Equation (2) gives a ratio of mean CPUE for vessel x to mean CPUE for vessel y using the same data as in (1). Comparing (1) and (2) would thus give an indication of the consistency of RFP over all "area-date" observations included in the calculation of RFP.

Results and Conclusions

Calculated values of (1) and (2) are listed in Tables 1-3 by country. The indices calculated from equation (1) seem to be consistently higher than those resulting from equation (2). For situations where there were at least 20 observations for Japanese vessels, fishing power coefficients varied 200% of the smallest RFP. As expected, the percentage increased as the number of observations in the sample decreased. This phenomenon did not occur with FRG or Polish data. In both FRG and Polish data sets the RFP's varied from 100% to 500% of the smallest fishing power regardless of which vessel was the reference vessel y.

The standard deviation and coefficient of variation of each fishing power coefficient (1) was computed (Tables 1-3). These statistics also show a tremendous amount of variation in the fishing power of a vessel. The coefficients of variation were often above 100% and seldom did they fall below 50%. To examine this more fully, for each country, plots of CPUE of vessel x vs CPUE vessel y used in calculating (1) for data constituting the largest sample (n) were examined to assess the consistency and variability over time and area, of RFP (Figures 1-3). In neither three cases did the points fall along the line with slope (1). The scattering was also not along the line with slope (2). For the data used in these plots, distributions were drawn for vessel CPUE (Figures 1-3). For the three cases considered the distributions differed: the distributions of the vessels of FRG approached a Normal distribution, the data of Poland was much more skewed for each vessel, and that of Japan had little variance. Moreover, the distributions within country were more similar than those between country.

Figure 4 shows a plot of the distribution of CPUE $(x)_i$/CPUE $(y)_i$ for the three pairs of vessels used in Figures 1-3. In each plot, 30%-50% of the observations were less than 1.00. The reciprocal relationship would be the case in plotting the distribution of this ratio with x and y interchanged. Thus, the plots indicate the lack of consistency in RFP of the three vessels x, with y as the standard.

Literature cited

ICNAF 1974. Report of meeting of Working Group of Experts on the Practicability of Effort Limitation, Proceedings No. 4, Int. Comm. Northw. Atlant. Fish., Proc. Sp. Comm. Meet. Jan., 1974, Part II: 59-65.

The five entries in the cell of the matrix represent for vessel X and vessel Y (1) the number of days vessel X and vessel Y fished simultaneously in the same "area-date" block, (2) the relative fishing power (RFP) of vessel X, with vessel Y as reference vessel (re: equation (1)), (3) the ratio of CPUE of vessel X to the CPUE of vessel Y (re: equation (2)), (4) the standard deviation of the observations constituting RFP of vessel X, and (5) the coefficient of variation of the observations constituting RFP, i.e. standard deviation/RFP.

Table IA FRG 1972

VESSEL X

```
********************* VESSEL  Y                          ****
*        1     2     3     4     5     6     7     8     9    10
*************************************************************

*  1   48.   33.   34.   35.   28.   25.   25.   27.   12.   21.
*      1.0   2.5   1.5   1.5   1.8   2.3   3.3   2.4   3.2   3.8
*      1.0   1.4   1.5   1.5   1.3   2.0   3.0   2.2   1.9   2.7
*       .1   3.3   1.2   1.3   2.3   1.5   3.2   1.4   4.3   4.2
*     14.7130.6  80.5  88.4129.2  65.2  96.5  59.6134.0109.9

*  2   33.   59.   40.   36.   41.   25.   34.   33.   16.   25.
*      1.0   1.0   1.6   1.4   1.3   2.4   2.6   2.9   1.4   2.4
*       .7   1.0   1.2   1.3   1.0   1.6   2.4   1.9   1.4   2.0
*      1.0    .2   3.1   1.8   1.2   3.8   3.2   3.7    .9   2.2
*    104.5  18.9190.2129.7  94.7160.0123.7128.9  66.6  94.8

*  3   34.   40.   63.   39.   39.   29.   38.   38.   24.   24.
*       .8   1.3   1.0   1.1   1.0   1.6   2.5   2.1   2.0   2.2
*       .7    .9   1.0   1.0    .8   1.3   2.3   1.6   1.8   1.6
*       .6   2.2    .3   1.2    .9   1.6   3.8   2.2   2.8   2.2
*     77.3171.5  29.6106.3  90.6102.9149.0104.2134.9  99.6

*  4   35.   36.   39.   58.   36.   31.   27.   32.   15.   23.
*       .8   1.2   1.1   1.0   1.1   1.3   1.7   1.6   2.9   2.7
*       .7    .8   1.0   1.0    .9   1.3   2.1   1.6   1.5   1.8
*       .5   1.2   1.0    .3    .8    .8   1.7   1.1   6.6   2.4
*     59.6105.5  91.4  27.5  71.0  60.2105.2  69.2224.4  88.2

*  5   28.   41.   39.   36.   60.   24.   32.   33.   22.   32.
*      1.0   1.3   1.2   1.3   1.0   1.6   1.6   2.5   1.9   2.6
*       .8   1.0   1.2   1.1   1.0   1.5   2.3   2,1   1.5   2.3
*       .8   1.2   1.0   1.6    .1   1.2   1.5   1.7   2.0   1.7
*     75.4  95.2  86.3119.9  13.1  71.6  91.5  68.7105.5  66.2

*  6   25.   25.   29.   31.   24.   46.   20.   18.   15.   12.
*       .6   1.0    .8    .9   1.0   1.0   1.5   1.4   1.5   1.3
*       .5    .6    .8    .8    .7   1.0   1.1   1.1   1.1   1.2
*       .4    .8    .7    .5   1.1    .0   1.7    .9   1.7    .5
*     78.5  86.1  87.1  62.1118.2    .1117.0  66.6114.1  37.4

*  7   25.   34.   38.   27.   32.   20.   48.   37.   12.   25.
*       .3    .5    .5    .4    .5   1.0   1.0   1.0    .6   1.5
*       .3    .4    .4    .5    .4    .9   1.0    .8    .7   1.0
*       .3    .6   1.0    .5    .4   1.0    .4   1.1    .5   2.1
*     87.8104.2181.8115.8  88.0105.3  55.1109.3  84.5142.2

*  8   27.   33.   38.   32.   33.   18.   37.   56.   16.   28.
*       .5    .8    .9    .7    .6   1.0   1.0   1.0   1.0   1.5
*       .5    .5    .6    .6    .5    .9   1.2   1.0    .8   1.3
*       .3    .8    .9    .4    .3    .6   1.0    .1    .9   1.0
*     51.7102.0102.7  66.8  56.0  59.1  97.2  13.6  87.2  68.9

*  9   12.   16.   24.   15.   22.   15.   12.   16.   35.   11.
*       .7    .7    .7    .9    .8   1.1    .8   1.4   1.0   2.0
*       .5    .7    .6    .7    .7    .9   1.4   1.2   1.0   1.5
*       .8    .5    .7    .6    .6    .9    .7   1.0    .2   2.0
*    113.8  69.2  92.9  66.4  72.3  85.1  85.5  70.9  25.0100.6

* 10   21.   25.   24.   23.   32.   12.   25.   28.   11.   43.
*       .5    .6    .8   1.0    .5    .9    .7    .9   1.1   1.0
*       .4    .5    .6    .5    .4    .9   1.0    .8    .7   1.0
*       .3    .5    .8   2.0    .3    .3    .7    .5   1.0    .2
*     63.3  82.7  99.1203.0  61.0  35.3  98.6  58.8  90.4  15.6
```

Table 1B. See caption with Table 1A for explanation of entries in matrix.

FRG 1973

VESSEL Y

VESSEL X

```
 .................  VESSEL Y                        .................
     11    12    13    14    15    16    17    18    19    20    21    22    23*
 ..............................................................................

* 11  43.   10.   27.   16.   25.   23.   12.    9.   22.    3.   16.    0.    0.*
*     1.0   2.1   1.7   1.4   1.7   1.0   2.8   1.4   1.3   1.0   1.6    .0    .0*
*     1.0   1.9   1.6   1.3   1.3    .8   1.3   1.1   1.0   1.1   1.3
*      .0    .7    .7    .6   1.4    .6   5.3   1.1   1.0    .9   1.7    .0    .0*
*      .0  31.2  40.8  45.7  81.0  63.6 189.7  74.9  80.2  92.8 106.4    .0    .0*
*
* 12  10.   19.   13.    7.   11.    6.    1.    3.    3.    0.    5.    0.    0.*
*      .5   1.0    .9    .4   1.0    .6    .5   1.5    .6    .0   1.0    .0    .0*
*      .5   1.0    .8    .4    .7    .4    .5    .7    .4    .0    .8    .0    .0
*      .2    .0    .5    .1    .9    .4    .0   1.8    .4    .0    .7    .0    .0*
*    38.2    .0  58.9  32.9  80.2  66.7    .0 120.8  67.0    .0  70.2    .0    .0*
*
* 13  27.   13.   40.   18.   27.   21.    6.    7.   18.    0.   12.    0.    0.*
*      .7   1.5   1.0    .9   1.2    .5    .8   1.3   1.1    .0   1.3    .0    .0*
*      .6   1.3   1.0    .8    .9    .4    .7   1.1    .7    .0    .9    .0    .0
*      .2    .6    .0    .4    .9    .3    .4    .9   1.2    .0   1.3    .0    .0*
*    36.9  40.9    .1  41.7  72.8  50.7  45.6  64.4 105.4    .0  99.1    .0    .0*
*
* 14  16.    7.   18.   31.   21.   21.    5.    5.   15.    2.   10.    0.    2.*
*      .9   2.6   1.5   1.0   1.7    .7   2.6   2.1   1.4   1.3   1.6    .0    .7*
*      .8   2.4   1.2   1.0   1.2    .6   1.2   1.7    .9   1.3   1.3    .0    .7
*      .4    .9   1.3    .0   1.1    .5   3.2   1.4   1.3    .0    .8    .0    .0*
*    49.8  34.1  83.4    .1  63.6  51.5 123.5  66.9  90.8   2.1  53.0    .0   2.3*
*
* 15  25.   11.   27.   21.   48.   26.   10.   10.   25.    4.   14.    0.    3.*
*      .9   1.7   1.3    .9   1.0    .8    .9   1.2   1.1   1.4   1.6    .0    .5*
*      .9   1.4   1.2    .8   1.0    .6    .8   1.0    .7   1.3    .8    .0    .5
*      .5   1.4    .9    .6    .0    .6    .4    .7    .9   1.3   3.1    .0    .2*
*    58.9  84.4  67.1  72.3    .1  76.8  49.8  57.7  82.4  94.2 192.3    .0  34.1*
*
* 16  23.    6.   21.   21.   26.   48.   15.    9.   26.    4.   14.    0.    2.*
*     1.7   2.8   2.7   2.0   2.5   1.0   2.1   2.3   1.9   1.1   1.7    .0    .9*
*     1.3   2.3   2.4   1.9   1.6   1.0   1.2   2.0   1.5   1.1   1.5    .0    .9
*     1.9   2.3   1.7   1.4   2.4    .0   3.3   1.1   1.5    .5   1.2    .0    .0*
*    82.1  81.0  62.5  69.2  96.9    .1 158.2  46.2  76.2  40.1  70.5    .0   3.2*
*
* 17  12.    1.    6.    5.   10.   15.   24.    7.   11.    3.   10.    0.    0.*
*     1.0   2.0   1.5    .8   1.4   1.2   1.0   1.1   1.3    .8   2.1    .0    .0*
*      .8   2.0   1.4    .8   1.3    .9   1.0   1.0    .9    .8   1.1    .0    .0
*      .7    .0    .7    .6    .6   1.0    .0    .5   1.2    .1   3.4    .0    .0*
*    68.5    .0  45.5  69.4  42.1  84.5    .1  43.2  92.9  11.1 162.1    .0    .0*
*
* 18   9.    3.    7.    5.   10.    9.    7.   36.   18.   14.   16.    5.   10.*
*     1.2   1.6   1.0    .6   1.2    .5   1.2   1.0   1.4   1.0    .9    .7    .8*
*     1.0   1.4    .9    .6   1.0    .5   1.0   1.0    .5    .9    .8    .7    .8
*     1.0   1.2    .5    .2    .7    .2    .7    .0   2.0    .4    .7    .2    .3*
*    83.6  73.3  54.5  37.2  57.2  43.3  63.5    .0 143.9  39.1  84.8  23.7  35.3*
*
* 19  22.    3.   18.   15.   25.   26.   11.   18.   46.    9.   16.    3.   10.*
*     1.3   3.0   1.5   1.3   2.7    .8   1.4   2.4   1.0   2.5   1.6    .7   1.7*
*     1.0   2.6   1.3   1.2   1.5    .7   1.1   1.9   1.0   2.4   1.3    .7   1.3
*     1.0   3.0   1.1    .8   6.4    .5   1.0   3.8    .0   4.0   1.9    .7   3.5*
*    82.0  99.3  71.7  64.2 237.5  65.4  68.6 158.0    .1 162.2 118.5 100.4 201.7*
*
* 20   3.    0.    0.    2.    4.    4.    3.   14.    9.   28.   11.    3.   19.*
*     2.1    .0    .0    .8   1.3   1.0   1.3   1.3   1.6   1.0    .8    .4    .9*
*      .9    .0    .0    .8    .8    .9   1.3   1.1    .4   1.0    .8    .4    .7
*     2.1    .0    .0    .0   1.0    .5    .1    .8   2.2    .0    .4    .0    .7*
*    98.9    .0    .0   2.1  76.7  52.1  11.5  65.1 131.4    .2  46.5   6.8  86.0*
*
* 21  16.    5.   12.   10.   14.   14.   10.   16.   16.   11.   37.    2.    8.*
*     1.0   1.5   1.1    .8   1.6    .8   1.0   1.6   1.5   1.5   1.0    .8   1.2*
*      .8   1.2   1.1    .7   1.2    .7    .9   1.3    .7   1.3   1.0    .8   1.1
*      .8   1.1    .5    .3   1.2    .4    .6    .7   1.5    .8    .0    .3    .5*
*    82.0  73.3  46.1  44.4  72.5  52.8  54.7  46.3 100.8  54.4    .1  31.9  39.7*
*
* 22   0.    0.    0.    0.    0.    0.    0.    5.    3.    3.    2.   14.   10.*
*      .0    .0    .0    .0    .0    .0    .0   1.4   6.1   2.3   1.3   1.0   1.4*
*                                              1.4   1.5   2.3   1.2   1.0   1.4
*      .0    .0    .0    .0    .0    .0    .0    .3   8.4    .2    .4    .0    .8*
*      .0    .0    .0    .0    .0    .0    .0  22.4 136.5   7.0  31.9    .1  54.1*
*
* 23   0.    0.    0.    2.    3.    2.    0.   10.   10.   19.    8.   10.   25.*
*      .0    .0    .0   1.4   2.2   1.1    .0   1.4   2.7   1.8   1.0    .9   1.0*
*                       1.4   1.9   1.1    .0   1.3    .9   1.4    .9    .7   1.0
*      .0    .0    .0    .0    .7    .0    .0    .5   2.8   1.5    .6    .4    .0*
*      .0    .0    .0   2.3  31.2   3.2    .0  36.2 106.8  87.5  58.1  49.2    .2*
*
 *STOP
```

Table 2A. See caption with Table 1A for explanation of entries in matrix.

Poland 1971

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 *******************          VESSEL  Y              *********************
 *        1     2     3     4     5     6     7     8     9    10    11    12
 ****************************************************************************

 *   1   32.   28.   27.   11.   30.    0.   33.    0.   12.    0.    9.   26.
 *       1.9   1.2   1.2   1.5    .9    .0   1.7    .0   2.3    .0   1.4    .9
 *-->    1.0    .8    .9    .7    .7    .0    .5    .0   1.5    .0    .7    .5
 *        .0   1.2   1.0   2.1    .6    .0   5.9    .0   2.3    .0   3.0   1.1
 *        .0100.3  82.6143.0103.6    .0351.8    .0102.8    .0212.6123.4
                       .6
 *   2   28.   46.   35.   15.   32.    0.   36.    0.   13.    0.    9.   24.
 *       2.9   1.0   2.4   2.4   1.5    .0   1.7    .0   2.9    .0   1.2    .8
 *       1.2   1.0   1.2   1.1   1.0    .0   1.1    .0   1.2    .0   1.0    .6
 *       4.3    .9   3.9   2.6   1.3    .0   1.6    .0   4.6    .0   1.1    .9
 *     147.1    .1164.3109.5  85.6    .0 97.0    .0158.4    .0  92.1111.0

 *   3   27.   35.   45.   14.   34.    0.   32.    0.   12.    0.    7.   26.
 *       1.4   1.1   1.0   1.4   1.3    .0    .8    .0   2.2    .0    .9    .8
 *       1.1    .8   1.0    .9    .9    .0    .7    .0   1.4    .0    .8    .5
 *       1.1   1.1    .1   1.3   1.1    .0    .7    .0   2.9    .0    .7   1.2
 *      74.7100.6  15.2  96.5  86.2    .0  85.6    .0131.9    .0  77.6161.4

 *   4   11.   16.   14.   21.   13.    0.   16.    0.    9.    0.    0.   11.
 *       2.0   1.2   1.4   1.0   1.2    .0    .8    .0   3.6    .0    .0    .7
 *       1.3    .9   1.1   1.0    .9    .0    .7    .0   2.3    .0    .0    .8
 *       1.7   1.3   1.3    .0   1.0    .0    .6    .0   3.6    .0    .0    .7
 *      85.9109.4  94.1    .1  79.9    .0  78.0    .0101.0    .0    .0  83.1

 *   5   30.   32.   34.   13.   41.    0.   35.    0.   12.    0.    9.   24.
 *       3.0   1.5   2.3   1.7   1.0    .0    .9    .0   1.5    .0   2.3    .8
 *       1.3   1.0   1.1   1.8   1.0    .0    .8    .0   1.5    .0   1.1    .6
 *       4.3   1.5   4.9   1.5    .0    .0    .6    .0   1.0    .0   3.2    .7
 *     159.1105.4216.8  87.9    .1    .0  77.1    .0  67.6    .0137.2  93.8

 *   6    0.    0.    0.    0.    0.   11.    3.    9.    0.    2.    0.    5.
 *        .0    .0    .0    .0    .0   1.0   1.2    .8    .0    .4    .0   1.2
 *        .0    .0    .0    .0    .0   1.0    .8    .6    .0    .4    .0    .8
 *        .0    .0    .0    .0    .0    .0   1.2    .5    .0    .1    .0    .5
 *        .0    .0    .0    .0    .0    .0  99.6  75.0    .0  22.4    .0  52.2

 *   7   33.   36.   32.   16.   35.    3.   61.   12.   14.    6.    9.   33.
 *       3.7   1.2   3.0   2.5   1.7   1.7   1.0    .8   3.4   2.4   1.0    .9
 *       2.1    .9   1.4   1.5   1.2   1.3   1.0    .6   2.2   1.3    .8    .6
 *       4.4   1.1   5.3   2.4   1.3   1.5    .1    .7   4.7   2.3    .8    .7
 *     120.7  97.0 192.3  93.8  75.2  89.3  13.0  78.8135.7  98.8  81.3  84.6

 *   8    0.    0.    0.    0.    0.    9.   12.   20.    0.    4.    0.   11.
 *        .0    .0    .0    .0    .0   2.3   2.1   1.0    .0   5.5    .0   1.3
 *        .0    .0    .0    .0    .0   1.6   1.6   1.0    .0   1.5    .0    .8
 *        .0    .0    .0    .0    .0   1.3   1.5    .0    .0   9.5    .0   1.2
 *        .0    .0    .0    .0    .0  64.2  73.6    .1    .0172.0    .0  92.7

 *   9   12.   13.   13.    5.   12.    0.   14.    0.   17.    0.    0.   10.
 *       1.3   1.8    .7    .4   1.2    .0    .5    .0   1.0    .0    .0    .4
 *        .7    .8    .7    .4    .7    .0    .5    .0   1.0    .0    .0    .4
 *       2.0    .7    .5    .3   1.2    .0    .4    .0    .0    .0    .0    .3
 *     153.7  74.7  90.1  52.6  98.1    .0  67.5    .0    .1    .0    .0  71.6

 *  10    0.    0.    0.    0.    0.    2.    6.    4.    0.   18.    0.   12.
 *        .0    .0    .0    .0    .0   2.3    .9   1.0    .0   1.0    .0    .6
 *        .0    .0    .0    .0    .0   2.5    .9    .7    .0   1.0    .0    .6
 *        .0    .0    .0    .0    .0    .5    .9    .7    .0    .0    .0    .3
 *        .0    .0    .0    .0    .0  22.4  93.3  66.5    .0    .0    .0  54.2

 *  11    9.    9.    7.    0.    9.    0.    9.    0.    0.    0.   12.    5.
 *       3.2   1.6   3.4    .0    .9    .0    .9    .0    .0    .0   1.0    .8
 *       1.4   1.1   1.2    .0    .9    .0   1.2    .0    .0    .0   1.0    .9
 *       4.1   1.4   5.3    .0    .0    .0    .9    .0    .0    .0    .3    .7
 *     126.1  87.5157.1    .0  88.9    .0101.9    .0    .0    .0  31.5  83.5

 *  12   26.   23.   26.   11.   24.    5.   33.   11.   13.   12.    5.   60.
 *       4.5   2.5   3.7   1.7   2.3   1.9   1.6   1.5   3.9   3.2   4.1   1.0
 *       1.8   1.8   2.0   1.2   1.6   1.3   1.5   1.2   2.5   1.7   1.2   1.0
 *       5.3   2.3   3.7   1.5    .3   2.7   1.3   1.3   3.2   4.8   6.0    .1
 *     113.9  95.9129.1  90.  102.1143.9  67.8  71.1  81.8150.3147.5  13.1
```

VESSEL X

D 7

Table 2B. See caption with Table 1A for explanation of entries in matrix.

Poland 1972

VESSEL Y

VESSEL X

	13	14	15	16	17	18	19	20	21	22
* 13	31.	19.	21.	21.	19.	10.	22.	0.	.0.	16.
*	1.0	.8	1.3	1.2	1.4	.7	1.0	.0	.0	.6
*	1.0	.7	1.2	.7	1.2	.7	.9	.0	.0	.4
*	.2	.9	1.1	1.4	3.1	.3	.9	.0	.0	.6
*	19.6	105.7	84.4	118.9	215.4	115.1	88.5	.0	.0	93.5
* 14	18.	26.	19.	15.	16.	9.	15.	0.	0.	13.
*	2.4	1.0	1.5	1.9	1.6	1.5	2.1	.0	.0	1.3
*	1.4	1.0	1.3	1.2	1.4	1.5	1.7	.0	.0	.8
*	2.1	.0	1.1	2.3	2.3	1.5	1.6	.0	.0	1.0
*	86.7	.0	72.5	119.6	142.1	105.6	75.1	.0	.0	77.7
* 15	21.	19.	52.	25.	24.	11.	15.	6.	6.	26.
*	1.8	1.2	1.0	1.3	1.1	.9	1.5	5.7	1.7	1.2
*	.8	.7	1.0	.8	1.1	1.0	1.0	1.3	1.1	.8
*	2.2	1.0	.1	1.4	1.7	.8	1.0	7.5	1.6	1.4
*	124.7	81.1	14.1	110.2	143.8	87.1	67.3	132.3	95.1	115.7
* 16	21.	15.	25.	36.	19.	9.	16.	0.	0.	23.
*	2.5	1.3	1.7	1.0	1.2	1.8	2.2	.0	.0	1.1
*	1.4	.9	1.2	1.0	1.1	1.5	1.9	.0	.0	.7
*	2.7	1.4	1.5	.2	1.2	2.9	1.8	.0	.0	1.3
*	102.9	109.5	86.8	17.1	99.4	161.2	82.3	.0	.0	122.7
* 17	19.	16.	24.	19.	33.	11.	12.	0.	0.	15.
*	2.3	1.1	1.7	1.5	1.0	2.3	1.9	.0	.0	2.3
*	.9	.7	.9	.9	1.0	1.4	1.3	.0	.0	1.1
*	3.3	1.1	2.5	1.6	.4	2.9	1.3	.0	.0	2.9
*	156.1	107.1	147.6	103.5	47.9	124.7	134.3	.0	.0	132.8
* 18	19.	9.	11.	9.	11.	24.	8.	0.	0.	19.
*	2.6	1.0	1.5	1.1	.6	1.0	1.7	.0	.0	2.4
*	1.4	.7	1.0	.7	.7	1.0	1.4	.0	.0	.9
*	3.6	1.2	2.1	1.2	.5	.3	1.7	.0	.0	3.3
*	135.3	125.2	140.3	102.5	87.8	38.6	101.1	.0	.0	134.1
* 19	22.	15.	15.	16.	12.	8.	25.	0.	0.	14.
*	1.5	1.0	1.2	.7	.9	.6	1.0	.0	.0	1.0
*	1.1	.6	1.0	.5	.8	.7	1.0	.0	.0	.4
*	1.4	1.2	.9	.6	1.0	.8	.2	.0	.0	2.0
*	91.7	123.2	81.2	91.9	118.1	124.7	20.8	.0	.0	200.6
* 20	0.	0.	6.	0.	0.	0.	0.	15.	[illegible]	3.
*	.0	.0	.7	.0	.0	.0	.0	1.0	.5	1.5
*	.0	.0	.8	.0	.0	.0	.0	1.0	.7	.8
*	.0	.0	.9	.0	.0	.0	.0	.3	.3	2.6
*	.0	.0	137.3	.0	.0	.0	.0	274.7	124.0	173.8
* 21	0.	0.	6.	0.	0.	0.	0.	9.	23.	15.
*	.0	.0	1.0	.0	.0	.0	.0	2.4	1.0	2.5
*	.0	.0	.9	.0	.0	.0	.0	1.4	1.0	1.0
*	.0	.0	.0	.0	.0	.0	.0	1.8	.0	4.1
*	.0	.0	66.3	.0	.0	.0	.0	77.5	[illegible]	163.3
* 22	16.	13.	26.	23.	15.	19.	14.	8.	15.	60.
*	3.2	1.6	1.8	2.3	.8	1.1	3.2	3.0	1.5	1.0
*	2.4	1.2	1.3	1.5	.9	1.2	2.3	1.3	1.0	1.0
*	3.2	1.6	1.5	2.3	1.9	2.1	3.6	4.2	1.0	.0
*	99.0	101.7	83.0	103.4	132.2	185.4	110.6	139.7	68.3	.1

Table 3A. See caption with Table 1A for explanation of entries in matrix.
Japan 1971

VESSEL Y

VESSEL X

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	18. 1.0 1.0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	1. .8 .8 .0 .0	5. 2.4 1.7 2.8 118.9	0. .0 .0 .0 .0	0. .0 .0 .0 .0	2. 1.1 1.3 .5 40.2	6. .7 .6 .5 73.3	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	9.* 1.9 1.7 .6 34.2
2	0. .0 .0 .0 .0	7. 1.0 1.0 .0 .1	0. .0 .0 .0 .0	0. .0 .0 .0 .0	1. 2.0 2.0 .0 .0	1. 2.3 2.3 .0 .0	1. 7.9 7.9 .0 .0	2. 3.0 2.7 1.6 52.4	4. 1.4 1.5 .8 55.6	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0.* .0 .0 .0 .0
3	0. .0 .0 .0 .0	0. .0 .0 .0 .0	10. 1.0 1.0 .0 .1	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	5. .7 .5 1.1 162.3	4. 1.3 1.3 .8 60.5	3. .4 .2 .6 144.1	2. .2 .3 .1 47.7	0. .0 .0 .0 .0	4.* 4.6 2.0 7.4 160.8
4	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	1. 1.0 1.0 .0 .0	1. 1.4 1.4 .0 .0	1. 1.3 1.3 .0 .0	0. .0 .0 .0 .0	1. 2.2 2.2 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0.* .0 .0 .0 .0
5	1. 1.2 1.2 .0 .0	1. .5 .5 .0 .0	0. .0 .0 .0 .0	1. .7 .7 .0 .0	16. 1.0 1.0 .0 .0	12. .8 .7 .3 37.1	0. .0 .0 .0 .0	8. 2.0 1.8 1.3 66.6	1. .6 .6 .0 .0	1. .3 .3 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0.* .0 .0 .0 .0
6	5. 1.2 .6 1.3 108.9	1. .4 .4 .0 .0	0. .0 .0 .0 .0	1. .8 .8 .0 .0	12. 1.7 1.4 1.2 73.3	16. 1.0 1.0 .0 .0	0. .0 .0 .0 .0	4. 4.0 3.3 2.2 55.9	0. .0 .0 .0 .0	3. .6 .5 .3 60.8	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0.* .0 .0 .0 .0
7	0. .0 .0 .0 .0	1. .1 .1 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	1. 1.0 1.0 .0 .0	0. .0 .0 .0 .0	1. .3 .3 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0.* .0 .0 .0 .0
8	0. .0 .0 .0 .0	2. .4 .4 .2 52.4	0. .0 .0 .0 .0	1. .5 .5 .0 .0	8. .7 .6 .4 57.9	4. .3 .3 .2 60.9	0. .0 .0 .0 .0	11. 1.0 1.0 .0 .0	1. .8 .8 .0 .0	1. .2 .2 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0.* .0 .0 .0
9	2. 1.0 .8 .4 40.2	4. 1.0 .7 .7 72.2	0. .0 .0 .0 .0	0. .0 .0 .0 .0	1. 1.8 1.8 .0 .0	0. .0 .0 .0 .0	1. 3.4 3.4 .0 .0	1. 1.3 1.3 .0 .0	7. 1.0 1.0 .0 .0	1. .7 .7 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0.* .0 .0 .0
10	6. 6.7 1.7 12.3 184.9	0. .0 .0 .0 .0	5. 8.1 2.1 10.4 128.1	0. .0 .0 .0 .0	1. 3.0 3.0 .0 .0	3. 2.2 2.0 1.0 45.1	0. .0 .0 .0 .0	1. 4.6 4.6 .0 .0	1. 1.4 1.4 .0 .0	39. 1.0 1.0 .0 .0	2. 2.9 2.0 2.9 101.4	26. 2.1 1.4 1.7 81.0	20. 4.3 2.4 3.8 88.5	1. .8 .9 .0 .0	2.* 5.9 2.2 7.2 122.7
11	0. .0 .0 .0 .0	0. .0 .0 .0 .0	4. 1.1 .8 .9 81.5	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	2. .7 .5 .7 101.4	5. 1.0 1.0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	1. 1.0 1.0 .0 .0	0.* .0 .0 .0 .0
12	0. .0 .0 .0 .0	0. .0 .0 .0 .0	3. 10.4 4.5 8.3 80.2	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	26. 1.1 .7 1.1 106.8	0. .0 .0 .0 .0	38. 1.0 1.0 .0 .0	28. 4.0 2.1 7.7 193.3	0. .0 .0 .0 .0	8.* 2.8 2.8 2.1 73.4
13	0. .0 .0 .0 .0	0. .0 .0 .0 .0	2. 4.8 3.9 2.3 47.7	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	20. .5 .4 .5 91.5	0. .0 .0 .0 .0	28. 1.2 .5 1.3 107.6	31. 1.0 1.0 .0 .0	0. .0 .0 .0 .0	5.* 3.4 .7 6.1 179.4
14	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	1. 1.3 1.3 .0 .0	1. 1.0 1.0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	1. 1.0 1.0 .0 .0	0.* .0 .0 .0 .0
15	9. .6 .6 .2 34.5	0. .0 .0 .0 .0	4. 1.5 .5 1.5 98.0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	0. .0 .0 .0 .0	2. .7 .5 .8 122.7	0. .0 .0 .0 .0	8. .6 .4 .4 65.4	5. 1.3 1.4 .8 63.2	0. .0 .0 .0 .0	18.* 1.0 1.0 .0 .0

D 9

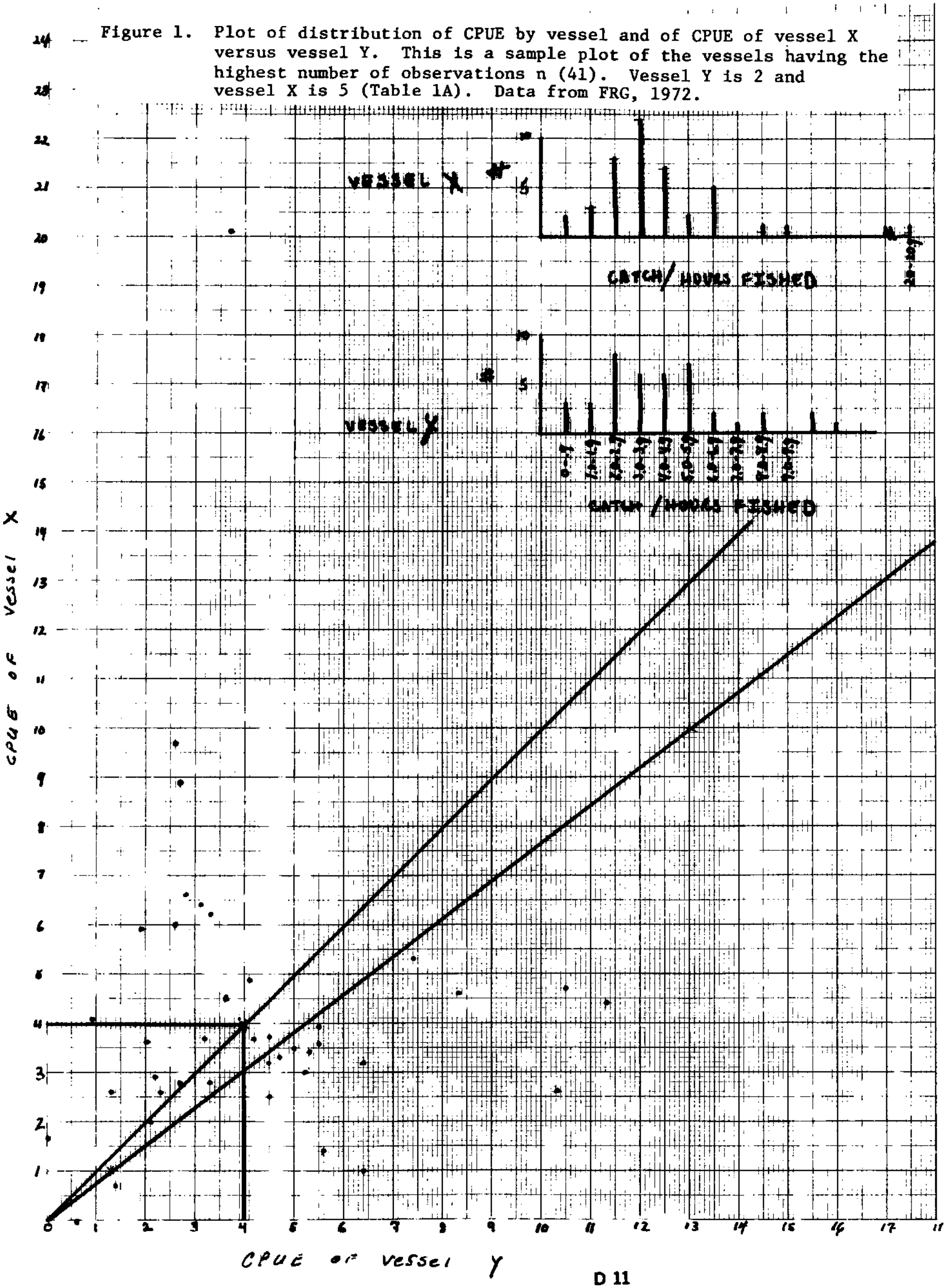
Table 3B. See caption with Table 1A for explanation of entries in matrix.
Japan 1972

VESSEL Y

VESSEL X

	16	17	18	19	20	21	22	23	24	25	26	27
16	8.	0.	0.	0.	0.	2.	5.	3.	7.	0.	1.	1.
	1.0	.0	.0	.0	.0	.6	1.1	4.0	1.1	.0	1.3	.8
	1.0	.0	.0	.0	.0	.6	1.1	2.2	1.0	.0	1.3	
	.0	.0	.0	.0	.0	.1	.5	4.3	.4	.0	.0	.0
	.0	.0	.0	.0	.0	17.5	39.6	107.9	41.1	.0	.0	.0
17	0.	14.	7.	0.	1.	8.	6.	4.	0.	1.	0.	7.
	.0	1.0	8.2	.0	.3	5.5	3.6	4.8	.0	.3	.0	3.7
	.0	1.0	2.4	.0	.3	1.4	.2	.9	.0	.3	.0	1.4
	.0	.0	8.1	.0	.0	6.6	3.3	3.6	.0	.0	.0	3.6
	.0	.0	99.6	.0	.0	120.3	90.5	74.5	.0	.0	.0	97.7
18	0.	7.	28.	6.	2.	6.	19.	7.	0.	4.	1.	9.
	.0	.5	1.0	5.8	3.2	1.0	.8	.3	.0	1.1	1.5	.8
	.0	.4	1.0	2.5	2.8	1.4	.3	.3	.0	.9	1.5	.8
	.0	.6	.0	11.2	1.1	.5	.6	.2	.0	.5	.0	.7
	.0	116.5	.0	193.9	35.7	53.3	79.1	60.5	.0	47.2	.0	90.2
19	0.	0.	6.	14.	2.	1.	7.	0.	0.	2.	5.	9.
	.0	.0	.8	1.0	3.3	.1	.8	.0	.0	.4	1.4	.8
	.0	.0	.4	1.0	2.0	.1	.7	.0	.0	.4	1.3	.4
	.0	.0	.5	.0	3.5	.0	.2	.0	.0	.2	.3	.6
	.0	.0	64.8	.0	104.3	.0	32.4	.0	.0	54.7	25.6	78.1
20	0.	1.	2.	2.	10.	3.	3.	2.	0.	7.	0.	2.
	.0	9.5	.3	.7	1.0	2.2	.6	.2	.0	.9	.0	.3
	.0	3.5	.4	.5	1.0	.8	.4	.2	.0	.9	.0	.3
	.0	.0	.1	.7	.0	3.1	.6	.1	.0	.3	.0	.3
	.0	.0	35.7	104.3	.0	143.4	107.1	41.0	.0	31.8	.0	95.0
21	2.	8.	6.	1.	3.	37.	12.	13.	13.	3.	0.	14.
	1.7	.6	1.3	15.6	1.8	1.0	1.6	1.1	2.2	1.9	.0	1.4
	1.8	.7	.7	15.6	1.2	1.0	1.5	.8	2.1	1.3	.0	1.1
	.3	.9	.6	.0	1.5	.0	.9	.9	1.1	1.7	.0	1.0
	17.5	141.1	48.9	.0	78.8	.0	58.4	80.3	50.1	89.4	.0	68.1
✓22	5.	6.	19.	7.	3.	12.	40.	10.	10.	2.	1.	12.
	1.0	3.7	4.1	1.5	3.6	.8	1.0	1.1	1.3	1.6	2.7	1.2
	.9	6.4	3.8	1.4	2.6	.7	1.0	.9	1.1	1.5	2.7	5.2
	.4	22.0	9.5	.5	3.1	.3	.0	.8	.6	.9	.0	1.0
	38.8	227.0	230.0	34.2	84.5	33.9	.0	73.5	43.9	61.0	.0	78.3
23	3.	4.	7.	0.	2.	13.	10.	45.	2.	2.	1.	29.
	.5	.9	2.7	.0	6.1	1.3	1.0	1.0	.7	5.8	.1	1.3
	.4	1.1	3.0	.0	5.6	1.2	1.1	1.0	.6	5.7	.1	1.2
	.4	1.4	1.6	.0	2.5	.8	.7	.1	.3	.6	.0	.6
	72.3	161.3	61.7	.0	41.0	58.6	68.5	15.2	42.0	10.6	.0	49.2
24	7.	0.	0.	0.	0.	13.	10.	2.	22.	0.	0.	6.
	1.1	.0	.0	.0	.0	.5	.9	1.7	1.0	.0	.0	.9
	1.0	.0	.0	.0	.0	.5	.9	1.6	1.0	.0	.0	.8
	.4	.0	.0	.0	.0	.2	.2	.7	.0	.0	.0	.3
	38.4	.0	.0	.0	.0	38.8	25.4	42.0	.0	.0	.0	36.8
25	0.	1.	4.	2.	7.	3.	2.	2.	0.	12.	0.	3.
	.0	2.9	1.2	3.0	1.2	1.9	.8	.2	.0	1.0	.0	1.8
	.0	2.9	1.1	2.8	1.1	.7	.7	.2	.0	1.0	.0	1.5
	.0	.0	.8	1.7	.3	2.5	.5	.0	.0	.0	.0	.9
	.0	.0	66.1	54.7	25.8	136.7	61.0	10.6	.0	.1	.0	47.5
26	1.	0.	1.	5.	0.	0.	1.	1.	0.	0.	7.	3.
	.8	.0	.7	.8	.0	.0	.4	6.8	.0	.0	1.0	1.1
	.8	.0	.7	.8	.0	.0	.4	6.8	.0	.0	1.0	1.1
	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.4
	.0	.0	.0	27.7	.0	.0	.0	.0	.0	.0	.1	39.1
27	1.	7.	9.	9.	2.	14.	12.	29.	6.	3.	3.	58.
	1.3	.6	1.6	5.1	5.9	1.0	1.0	1.0	1.3	.7	1.1	1.0
	1.3	.7	1.2	2.3	3.7	.9	.2	.8	1.3	.4	.9	1.0
	.0	.8	1.1	10.9	5.6	.6	.8	.4	.5	.4	.5	.1
	.0	135.1	69.0	215.8	95.0	58.8	72.9	40.8	38.8	58.8	48.2	13.4

Figure 1. Plot of distribution of CPUE by vessel and of CPUE of vessel X versus vessel Y. This is a sample plot of the vessels having the highest number of observations n (41). Vessel Y is 2 and vessel X is 5 (Table 1A). Data from FRG, 1972.



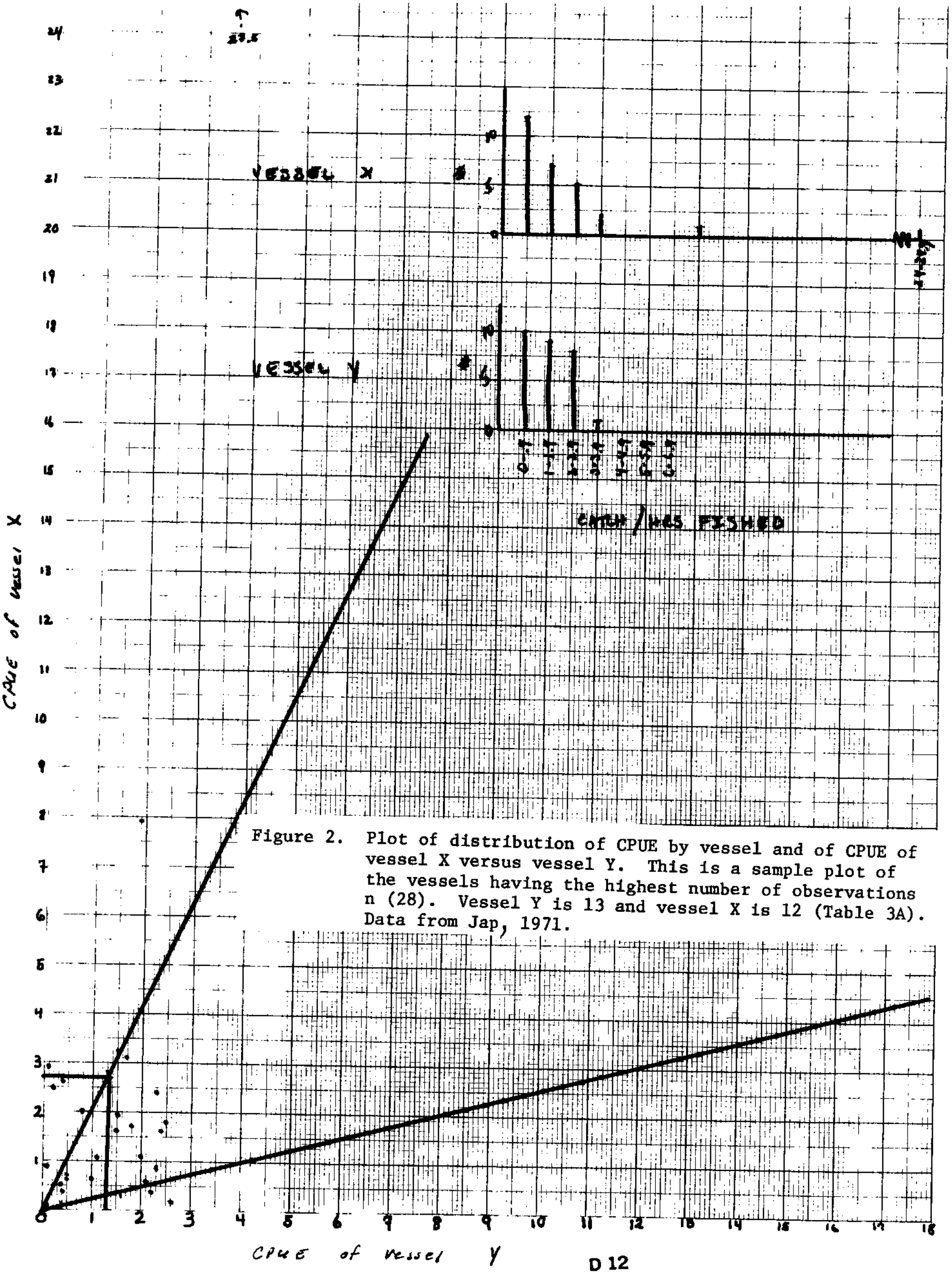


Figure 2. Plot of distribution of CPUE by vessel and of CPUE of vessel X versus vessel Y. This is a sample plot of the vessels having the highest number of observations n (28). Vessel Y is 13 and vessel X is 12 (Table 3A). Data from Jap, 1971.

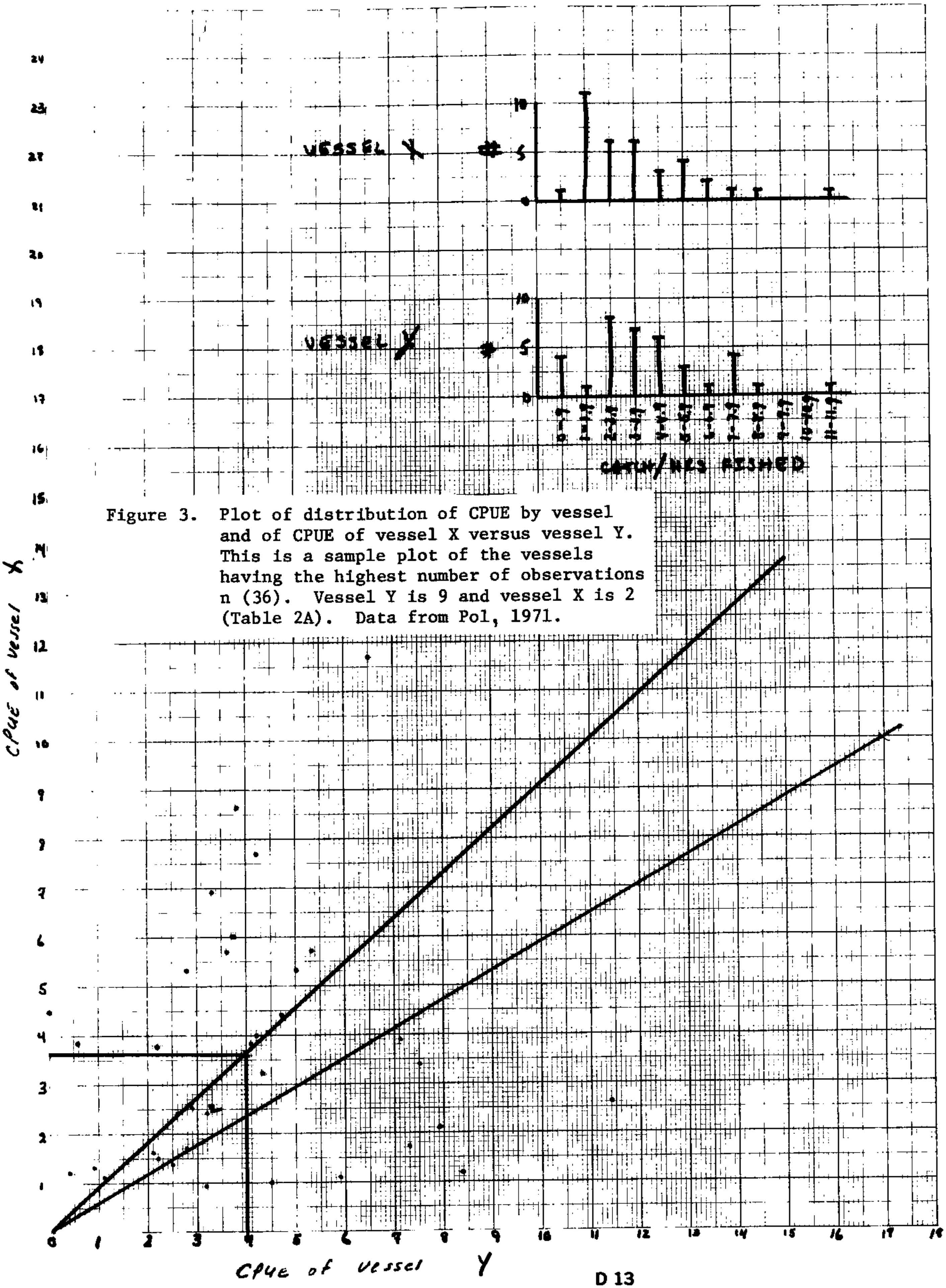


Figure 3. Plot of distribution of CPUE by vessel and of CPUE of vessel X versus vessel Y. This is a sample plot of the vessels having the highest number of observations n (36). Vessel Y is 9 and vessel X is 2 (Table 2A). Data from Pol, 1971.

FIGURE 4. DISTRIBUTION OF $CPUE(x)_i / CPUE(y)_i$ FOR DATA USED IN FIGURES 1-3, BY COUNTRY.