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# The commercial shrimp fishery in Denmark Strait in 1990 and early 1991

by

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## INTRODUCTION

STACFIS recommended that the total allowable catch of shrimp in the Denmark Strait in 1990 should be maintained at 10,000 tons. The total catch reported from the Greenland zone in Denmark Strait was 9,896 tons, of which Greenland vessels accounted for approximately 6,200 tons.

The fishery was carried out throughout the year, with most effort being spent from January to May and from September to December. Approximately 7,644 tons of shrimp were reported from the first half of the year and approximately 2,252 from the second half. From January to April 1991 a catch of about 6,000 tons has been reported.

Logbooks from all the 29 Greenland vessels fishing at East Greenland in 1990 are available to the Greenland Fisheries Research Institute, covering about 99% of the Greenland catches and about 62% of the total catches in the Greenland economic zone.

Shrimp samples from the commercial fishery in 1990 (127 samples) and early 1991 (38 samples) were analyzed for length-frequency distribution of shrimp in commercial catches.

The present paper updates information given by Carlsson and Kanneworff (1990) on catches and analysis of commercial fishery data.

## MATERIALS AND METHODS

Total catches and number of vessels fishing in the Greenland zone were compiled by nation and month based on the compulsory weekly reporting to Greenland authorities by all vessels above 75 GRT (smaller vessels are not joining this fishery).

Logbook data were analyzed to show the overall distribution of effort and catches, and of effort and catch-rates by month. Monthly mean catch-rates from 1980 to March 1991 were calculated from available logbook data.

Shrimp samples from the commercial fishery in April and October-November 1990 and in January-February 1991 were analyzed for size composition of catches. The samples were taken by observers in a project to estimate discards in the commercial fishery (Lehmann and Degel, 1991) and were unfortunately not sorted after sexual stage.

## RESULTS AND DISCUSSION

### Reported catches in 1990 and 1991.

Tables 1 and 3 show reported catches in the Greenland zone by nation and month, and Tables 2 and 4 the corresponding total numbers of reporting vessels for the years 1990 and 1991, respectively. The given catch figures should be considered minimum figures due to unreported discard of shrimp (Lehmann and Degel , 1991).

Since the start of the fishery in Denmark Strait the seasonal distribution has gradually levelled out from a pure winter-spring fishery to a fishery during most of the year except for June and July where only little effort has been spent. In 1990 about 23% of the reported catches were taken in the second half of the year.

In 1990 highest catches - especially by Greenland vessels - were taken in January through May, corresponding to 77% of the total for the year. Also in December a substantial catch was taken (approximately 700 tons).

In January-April 1991 a total catch of approximately 6,000 tons was reported (Table 3), which is at the same level as in 1989 and 1990 (5,779 and 5,848 tons, respectively) for the same period. A total of 45 vessels participated in the fishery (Table 4).

**Geographical distribution of the fishery.**

Fig. 1 shows the distribution of total catches by Greenland vessels in 1990, and Fig. 2 gives the monthly distribution of CPUE and effort from January to December 1990 by statistical rectangle.

The geographical distribution of the shrimp fishery in Denmark Strait has changed substantially between years, depending primarily on variations in ice coverage and the distribution of shrimp over the area (Carlsson and Kanneworff, 1990). In 1990 a considerable part of the fishery was located southwest of the traditionally most important areas, in the northern part of the so-called 'redfish-box'. This box is an area that was originally pointed out in the early eighties as an important nursery area for especially small redfish by the ICES Redfish Working Group and as such was closed for trawling. The area follows the east coast of Greenland from 63°30'N up to 67°N (the northern part is shown in Fig. 1). In March 1990 Greenland authorities opened a minor part of the area for the shrimp fishery (south of 66°N, east of 33°10'W - see Fig. 1), resulting in high catch rates and at the same time very little by-catch of redfish. Substantial catches were taken from this area in April and May.

The monthly distribution of the fishery in 1990 was in general similar to 1989, except for the new fishery in the western area west of 32°W. Taken by month the distribution was similar in January and February, but more widespread in March and April 1990. In May 1990 most effort was spent west of 32°W. In June, July and August there was - as in 1989 -very little fishing. In August, September and October 1989 there was a displacement of the fishery to the northeastern part of the fishing ground. This displacement was found again in September and October 1990. In November and December 1990 the fishery spread out over the area as in 1989, in 1990 - especially in December - with a considerable effort west of 32°W.

**Catch and effort.**

The semi-annual mean catch rates in 1990 were similar to those of 1989 (Table 6), however from January to June there is a significant difference in the monthly pattern. In 1990 the catch rates in January and February were lower than and in March similar to those of the same months in 1989. In April and May after the opening of the area west of 32°W catch rates increased to a level not found since December 1986 and January 1987 (Fig. 3, corresponding effort in Table 5). However, the effort spent in January to March is the highest by month over the year, comprising 65% of the total effort of the year, while the high catch rates in April and May are based on only 8.2% of the annual effort.

The overall development in mean catch rates from 1987 to 1990 (Table 6) is a decline from 1987 to 1989 and a presumable stabilization from 1989 to 1990, primarily due to the opening of the area west of 32°W. The lack of data from this area in earlier years makes it difficult to judge, whether the catch rates reflect a stabilization of the stock or it is only the effect of a fishery on a hitherto unexploited part of the stock. In general there are problems in defining the total stock distribution area as shown by the lack of small shrimp (less than about 18 mm CL) in samples and by the unsuccessful trawl survey by the Greenland Fisheries Research Institute in 1990 (Kanneworff and Lehmann, 1991).

It is in general difficult to draw firm conclusions from the reported catch rate figures due to variations in ice cover over the fishing grounds from year to year, improvement in gear technology, and changes in discarding procedures.

**By-catches in the shrimp fishery.**

By-catches are reported in logbooks from the shrimp fishery in similar amounts from year to year (2-3% of the shrimp catches) with redfish being the most dominant species, especially in February and March. However, as the reported levels can not be considered to be accurate, no compiling of data has been made.

**Biological samples.**

Shrimp samples from the commercial fishery in 1990 and 1991 were not sorted by sexual stage, and it is therefore difficult to distinguish especially primiparous females from multiparous females. Based on analysis of samples from the

commercial fishery in 1988 (Carlsson and Kanneworff, 1989) shrimp with carapace length (CL) less than 28 mm are mainly males. Primiparous females form a peak around 30 mm CL, and multiparous females group from 26 to 36 mm CL. Fig. 5 - 20 show length-frequency diagrams for pooled 1990-91 samples (weighted by catch) by month and statistical units used by Iceland (Fig. 4). Table 7 gives the numbers of shrimp by length group in these samples. The samples show considerable variation in size composition between areas. Samples from the northern areas (units 679, 680 and 730) show many male shrimp (less than 28 mm carapace length), and also in the southwestern areas (units 581 and 582) the male proportion is essential. Females are dominating in units 629 and 630, and in February 1991 also in unit 580 in the southern area. This is in accordance with results from the Norwegian trawl survey in 1989 (Smedstad, 1990). In the southern area, however, considerable number of males occurred in April 1990 and January 1991. Female peaks are found from 29.5 to 31.5 mm CL, consisting of both primiparous and multiparous components. There is a great variation in peaks of smaller shrimp (males and juveniles), but in many samples peaks at 21-22 mm and 24-25 mm CL are indicated.

## CONCLUSIONS

Reported catches of shrimp in 1990 from the Greenland part of Denmark Strait totalled 9,896 tons, similar to the catch in 1989. The total number of participating vessels was around 60 as in the years before. The mean catch per vessel was about 150 tons in 1989 and 1990. The fishery took place in all months of the year with very low activity in June and July. 77% of the catches were taken in the first half of the year.

In 1990 the geographical distribution of the fishery was similar to 1989, however the opening of a part of an area previously closed for trawling resulted in a displacement of the fishery to the west in some months.

Semiannual mean catch rates in 1990 were similar to 1989, however with a different pattern in the first half of the year when compared month by month. Mean catch rates in January and February were lower in 1990 and significantly higher in April and May, when the western area was fished.

Biological samples from the commercial fishery show the same size groups to be present as found earlier. Female shrimp dominate in the central part of the fishing grounds, while males are more frequent - and some times dominating - in the northern and western areas.

## REFERENCES

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Table 1. Catches of shrimp (tons) in Denmark Strait in 1990 by division, nation and month as reported to Greenland authorities.

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Greenland | 1,391 | 1,647 | 955 | 488 | 956 | 41 | 21 | 21 | 45 | 118 | 132 | 395 | 6,210 |
| Denmark | 75 | 23 | 100 | 6 | 98 | 0 | 12 | 19 | 14 | 24 | 16 | 3 | 390 |
| Faroe Island | 201 | 232 | 74 | 2 | 176 | 0 | 0 | 0 | 0 | 0 | 31 | 127 | 843 |
| France | 0 | 0 | 36 | 0 | 0 | 0 | 0 | 11 | 0 | 4 | 0 | 0 | 51 |
| Norway | 154 | 161 | 186 | 116 | 525 | 0 | 14 | 97 | 265 | 353 | 351 | 180 | 2,402 |
| TOTAL | 1,822 | 2,063 | 1,351 | 612 | 1,755 | 41 | 47 | 147 | 323 | 499 | 531 | 705 | 9,896 |

Table 2. No. of vessels in the shrimp fishery in Denmark Strait in 1990 by division, nation and month as reported to Greenland authorities.

| East Greenland | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Greenland | 26 | 22 | 22 | 8 | 12 | 2 | 4 | 5 | 3 | 7 | 10 | 15 | 29 |
| Denmark | 2 | 2 | 2 | 2 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| Faroe Islands | 5 | 6 | 6 | 2 | 4 | 0 | 0 | 0 | 0 | 0 | 2 | 7 | 10 |
| France | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 3 |
| Norway | 9 | 8 | 16 | 15 | 17 | 0 | 2 | 9 | 17 | 19 | 18 | 14 | 21 |
| TOTAL | 42 | 38 | 48 | 27 | 34 | 2 | 7 | 16 | 21 | 29 | 31 | 37 | 65 |

Table 3. Catches of shrimp (tons) in Denmark Strait in 1991 by division, nation and month as reported to Greenland authorities.

| | Jan | Feb | Mar | Apr | Total |
|---|---|---|---|---|---|
| Greenland | 1,019 | 954 | 564 | 1,094 | 3,631 |
| Denmark | 0 | 61 | 86 | 116 | 263 |
| Faroe Island | 230 | 279 | 110 | 42 | 661 |
| France | 0 | 32 | 27 | 54 | 113 |
| Norway | 331 | 375 | 203 | 467 | 1,376 |
| TOTAL | 1,580 | 1,701 | 990 | 1,773 | 6,044 |

Table 4. No. of vessels in the shrimp fishery in Denmark Strait in 1991 by division, nation and month as reported to Greenland authorities.

| East Greenland | Jan | Feb | Mar | Apr | Total |
|---|---|---|---|---|---|
| Greenland | 17 | 19 | 19 | 19 | 20 |
| Denmark | 0 | 1 | 2 | 2 | 2 |
| Faroe Islands | 3 | 3 | 3 | 1 | 3 |
| France | 0 | 1 | 1 | 2 | 2 |
| Norway | 12 | 16 | 17 | 15 | 18 |
| TOTAL | 32 | 40 | 42 | 39 | 45 |

Table 5. No. of hours trawled by year and month from April 1980 to March 1991 in the main fishing area in Denmark Strait as reported in available logbooks.

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | - | - | - | 35 | 1297 | 315 | 59 | 31 | 482 | 1166 | 464 | - | 3849 |
| 1981 | - | - | - | 1343 | 914 | 7 | - | - | - | - | - | - | 2264 |
| 1982 | - | - | 763 | 1570 | 1394 | - | - | - | - | - | - | - | 3727 |
| 1983 | - | - | 484 | 457 | - | - | - | - | - | - | - | - | 957 |
| 1984 | 105 | 312 | 281 | - | - | - | - | - | - | - | - | - | 698 |
| 1985 | 647 | 610 | 570 | 625 | - | - | - | - | - | 51 | 360 | 643 | 3506 |
| 1986 | 1565 | 2593 | 2413 | 1032 | 602 | - | - | - | - | 77 | 686 | 1160 | 10128 |
| 1987 | 3608 | 4471 | 2965 | 951 | 406 | - | - | 81 | 400 | 753 | 1915 | 4067 | 19617 |
| 1988 | 6951 | 7950 | 6408 | 1121 | 550 | - | - | 1019 | 1487 | 2586 | 3207 | 4903 | 36182 |
| 1989 | 6865 | 6361 | 3905 | 3505 | 2322 | 137 | 15 | 713 | 2290 | 2600 | 7031 | 7107 | 42851 |
| 1990 | 8602 | 8289 | 8299 | 1050 | 2133 | 116 | 82 | 351 | 710 | 1734 | 2121 | 5160 | 38647 |
| 1991 | 6367[1] | 3954[1] | 597[1] | - | - | - | - | - | - | - | - | - | 10918[1] |

[1] preliminary data

Table 6. Monthly and semi-annual mean catch rates, efforts and catches from 1987 to March 1991, based on logbooks from the Greenland fishery. Semi-annual efforts are calculated from total catches and CPUEs.

| Year | Month | CPUE | Effort | Catch | Month | CPUE | Effort | Catch |
|---|---|---|---|---|---|---|---|---|
| 1987 | JAN | 348 | 3608 | 1257.3 | AUG | 113 | 81 | 9.2 |
| | FEB | 322 | 4471 | 1439.0 | SEP | 253 | 400 | 101.4 |
| | MAR | 296 | 2965 | 878.6 | OCT | 199 | 753 | 149.7 |
| | APR | 208 | 951 | 197.6 | NOV | 162 | 1915 | 309.6 |
| | MAY | 298 | 406 | 121.0 | DEC | 115 | 4067 | 468.9 |
| Subtotal | | 314 | 12401 | 3893.5 | | 144 | 7216 | 1038.8 |
| Total | | 314 | 17667 | 5547.0 | | 144 | 7502 | 1080.0 |
| 1988 | JAN | 301 | 6951 | 2089.8 | AUG | 117 | 1019 | 119.6 |
| | FEB | 226 | 7950 | 1793.2 | SEP | 121 | 1487 | 179.4 |
| | MAR | 152 | 6408 | 975.1 | OCT | 105 | 2586 | 270.5 |
| | APR | 104 | 1121 | 116.0 | NOV | 157 | 3207 | 503.3 |
| | MAY | 114 | 550 | 62.9 | DEC | 203 | 4903 | 995.1 |
| Subtotal | | 219 | 22980 | 5037.0 | | 157 | 13202 | 2067.9 |
| Total | | 219 | 24111 | 5285.0 | | 157 | 13822 | 2165.0 |
| 1989 | JAN | 249 | 6865 | 1707.5 | JUL | 27 | 15 | 0.4 |
| | FEB | 214 | 6361 | 1361.0 | AUG | 44 | 713 | 31.3 |
| | MAR | 131 | 3905 | 512.1 | SEP | 59 | 2290 | 135.3 |
| | APR | 197 | 3505 | 690.6 | OCT | 96 | 2600 | 248.7 |
| | MAY | 68 | 2322 | 157.5 | NOV | 67 | 7031 | 474.1 |
| | JUN | 39 | 137 | 5.4 | DEC | 84 | 7107 | 598.9 |
| Subtotal | | 192 | 23095 | 4434.1 | | 75 | 19756 | 1488.7 |
| Total | | 192 | 23287 | 4471.0 | | 75 | 20039 | 1510.0 |
| 1990 | JAN | 139 | 8602 | 1196.8 | JUL | 94 | 82 | 7.7 |
| | FEB | 185 | 8289 | 1533.1 | AUG | 59 | 351 | 20.6 |
| | MAR | 143 | 8299 | 1186.1 | SEP | 64 | 710 | 45.2 |
| | APR | 473 | 1050 | 496.9 | OCT | 58 | 1734 | 101.4 |
| | MAY | 455 | 2133 | 971.5 | NOV | 65 | 2121 | 138.7 |
| | JUN | 45 | 116 | 5.2 | DEC | 79 | 5160 | 408.5 |
| Subtotal | | 189 | 28489 | 5389.6 | | 71 | 10158 | 722.1 |
| Total | | 189 | 28956 | 5478.0 | | 71 | 10297 | 732.0 |
| 1991 | JAN | 144 | 6367 | 914.0 | | | | |
| | FEB | 130 | 3954 | 513.5 | | | | |
| | MAR | 81 | 597 | 48.3 | | | | |
| Subtotal | | 135 | 10918 | 1475.8 | | | | |
| Total | | 135 | 31597 | 4271.0 | | | | |

Table 7a. No. of shrimp per length group in commercial samples from 1990, pooled by month and area (Iceland area units, see Fig. 4). 'Corresponding catch' is the catch represented by the samples.

| | YearMonth and Statistical Unit | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CL, mm | 9004 580 | 9004 582 | 9010 629 | 9010 630 | 9010 679 | 9010 680 | 9010 730 | 9011 629 |
| 14 | 0 | 907 | 0 | 0 | 0 | 311 | 354 | 0 |
| 14.5 | 254 | 1014 | 0 | 0 | 0 | 245 | 324 | 142 |
| 15 | 78 | 2987 | 0 | 0 | 0 | 236 | 419 | 223 |
| 15.5 | 132 | 0 | 23 | 35 | 0 | 251 | 337 | 165 |
| 16 | 262 | 3616 | 0 | 0 | 0 | 310 | 474 | 260 |
| 16.5 | 173 | 7581 | 23 | 12 | 0 | 431 | 591 | 78 |
| 17 | 48 | 4279 | 42 | 0 | 151 | 661 | 853 | 216 |
| 17.5 | 1790 | 23472 | 161 | 0 | 151 | 657 | 1249 | 297 |
| 18 | 1884 | 50143 | 103 | 0 | 0 | 1866 | 2290 | 130 |
| 18.5 | 2747 | 72248 | 76 | 111 | 0 | 2124 | 2496 | 401 |
| 19 | 3930 | 116158 | 299 | 153 | 0 | 2550 | 3664 | 485 |
| 19.5 | 4551 | 140922 | 170 | 102 | 301 | 4253 | 4699 | 267 |
| 20 | 6755 | 177504 | 321 | 135 | 0 | 4612 | 5431 | 231 |
| 20.5 | 6764 | 243954 | 538 | 176 | 0 | 6790 | 8212 | 625 |
| 21 | 9191 | 276646 | 1341 | 394 | 151 | 8848 | 9337 | 767 |
| 21.5 | 8868 | 293488 | 1370 | 317 | 151 | 9409 | 12225 | 1034 |
| 22 | 9724 | 322071 | 2289 | 323 | 452 | 11814 | 14534 | 1525 |
| 22.5 | 13892 | 387062 | 2741 | 465 | 151 | 12159 | 16486 | 1294 |
| 23 | 12034 | 337657 | 3433 | 495 | 452 | 13844 | 15848 | 2059 |
| 23.5 | 10040 | 353364 | 3876 | 745 | 452 | 14283 | 17475 | 1933 |
| 24 | 10295 | 342964 | 4084 | 702 | 452 | 14970 | 16000 | 2783 |
| 24.5 | 10581 | 325618 | 4132 | 1175 | 904 | 14132 | 15619 | 3021 |
| 25 | 9689 | 340247 | 4918 | 947 | 754 | 12132 | 14593 | 2481 |
| 25.5 | 9576 | 305515 | 5456 | 778 | 301 | 9991 | 13800 | 2907 |
| 26 | 9237 | 246191 | 5525 | 798 | 904 | 8405 | 11811 | 3157 |
| 26.5 | 8669 | 288578 | 4442 | 866 | 603 | 7752 | 9497 | 2644 |
| 27 | 6955 | 264293 | 5490 | 1151 | 603 | 6110 | 12015 | 3388 |
| 27.5 | 14817 | 286147 | 5875 | 1049 | 452 | 4952 | 10699 | 3711 |
| 28 | 12145 | 303728 | 8298 | 1315 | 603 | 4957 | 10031 | 4116 |
| 28.5 | 16318 | 354598 | 10489 | 2082 | 452 | 5719 | 13908 | 4477 |
| 29 | 17832 | 436605 | 13342 | 2146 | 452 | 6734 | 13470 | 6263 |
| 29.5 | 21947 | 605247 | 15467 | 2895 | 1055 | 4948 | 16415 | 6581 |
| 30 | 27003 | 804430 | 15932 | 2523 | 904 | 5538 | 17592 | 6406 |
| 30.5 | 25029 | 951997 | 14713 | 2510 | 904 | 6789 | 18402 | 6645 |
| 31 | 21733 | 911592 | 13714 | 2660 | 904 | 7320 | 15142 | 5373 |
| 31.5 | 18022 | 721058 | 11747 | 2018 | 603 | 5407 | 14894 | 3702 |
| 32 | 14655 | 523541 | 7962 | 1388 | 452 | 4721 | 10380 | 2938 |
| 32.5 | 9661 | 277664 | 6410 | 893 | 452 | 2726 | 7542 | 2379 |
| 33 | 6435 | 150827 | 3736 | 730 | 301 | 2154 | 5857 | 1562 |
| 33.5 | 3500 | 84504 | 1852 | 280 | 0 | 1297 | 2908 | 806 |
| 34 | 1747 | 32930 | 1048 | 219 | 151 | 1028 | 1965 | 315 |
| 34.5 | 1457 | 20376 | 404 | 85 | 151 | 415 | 940 | 145 |
| 35 | 481 | 4234 | 187 | 107 | 151 | 20 | 122 | 106 |
| 35.5 | 113 | 2479 | 155 | 25 | 0 | 0 | 471 | 35 |
| 36 | 149 | 0 | 67 | 25 | 0 | 0 | 25 | 0 |
| 36.5 | 277 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ALL | 371438 | 11400436 | 182251 | 32827 | 14921 | 233869 | 371394 | 88069 |
| No. of samples | 14 | 26 | 16 | 5 | 1 | 8 | 20 | 10 |
| Σ sample weight | 54.1 | 176.4 | 106.1 | 29.7 | 1.4 | 36.5 | 106.6 | 67.6 |
| Corresp. catch | 5236 | 135619 | 2950 | 533 | 211 | 2291 | 4787 | 1340 |

Table 7b. No. of shrimp per length group in commercial samples from 1990 and 1991, pooled by month and area (Iceland area units, see Fig. 4). 'Corresponding catch' is the catch represented by the samples.

| | YearMonth and Statistical Unit | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CL, mm | 9011 630 | 9011 679 | 9101 580 | 9101 581 | 9101 582 | 9102 580 | 9102 581 | 9102 582 |
| 14 | 0 | 0 | 0 | 0 | 99 | 0 | 215 | 0 |
| 14.5 | 0 | 0 | 0 | 0 | 0 | 0 | 82 | 268 |
| 15 | 0 | 0 | 187 | 151 | 366 | 0 | 179 | 203 |
| 15.5 | 0 | 0 | 262 | 0 | 106 | 0 | 213 | 375 |
| 16 | 0 | 0 | 488 | 267 | 211 | 0 | 110 | 279 |
| 16.5 | 0 | 0 | 393 | 399 | 129 | 0 | 458 | 352 |
| 17 | 0 | 0 | 650 | 816 | 321 | 0 | 174 | 1012 |
| 17.5 | 49 | 0 | 419 | 648 | 562 | 0 | 251 | 1447 |
| 18 | 49 | 13 | 1076 | 1289 | 199 | 0 | 499 | 1901 |
| 18.5 | 25 | 0 | 1685 | 3871 | 718 | 0 | 652 | 2716 |
| 19 | 124 | 46 | 2920 | 5861 | 2772 | 0 | 2172 | 4099 |
| 19.5 | 49 | 0 | 3958 | 8834 | 3900 | 0 | 2923 | 6703 |
| 20 | 25 | 46 | 4444 | 14740 | 6711 | 0 | 3360 | 8686 |
| 20.5 | 173 | 26 | 8235 | 16529 | 8716 | 66 | 4907 | 13351 |
| 21 | 25 | 118 | 9677 | 21527 | 10664 | 33 | 5820 | 13360 |
| 21.5 | 74 | 216 | 11909 | 29234 | 13462 | 33 | 6098 | 18743 |
| 22 | 148 | 183 | 12064 | 26634 | 13449 | 66 | 7286 | 19722 |
| 22.5 | 124 | 379 | 14171 | 24550 | 15650 | 33 | 5878 | 30291 |
| 23 | 148 | 419 | 13696 | 25970 | 22278 | 66 | 4937 | 33860 |
| 23.5 | 370 | 811 | 15021 | 23368 | 20946 | 33 | 4119 | 41032 |
| 24 | 272 | 797 | 12286 | 23680 | 25303 | 66 | 4526 | 35819 |
| 24.5 | 420 | 1138 | 10472 | 22223 | 28766 | 66 | 2571 | 44683 |
| 25 | 296 | 1210 | 9809 | 20536 | 36803 | 99 | 4398 | 40205 |
| 25.5 | 519 | 798 | 8602 | 17129 | 32591 | 165 | 2214 | 42959 |
| 26 | 420 | 1085 | 7250 | 16427 | 29912 | 132 | 3027 | 41364 |
| 26.5 | 370 | 1151 | 5976 | 19570 | 32591 | 198 | 3101 | 35915 |
| 27 | 395 | 1119 | 7089 | 21251 | 31469 | 231 | 3614 | 39924 |
| 27.5 | 321 | 1086 | 6653 | 18404 | 28165 | 395 | 3148 | 38228 |
| 28 | 519 | 1170 | 6897 | 27207 | 32528 | 362 | 5147 | 44490 |
| 28.5 | 593 | 1315 | 11063 | 28812 | 34644 | 527 | 5486 | 52911 |
| 29 | 938 | 1249 | 9494 | 38824 | 39804 | 889 | 8863 | 56233 |
| 29.5 | 889 | 1818 | 12879 | 49305 | 46496 | 1614 | 15386 | 62203 |
| 30 | 889 | 2001 | 13781 | 57345 | 45289 | 2437 | 18288 | 58000 |
| 30.5 | 914 | 2270 | 15257 | 65144 | 41764 | 2141 | 20409 | 53007 |
| 31 | 864 | 2126 | 13901 | 56699 | 38552 | 2569 | 17110 | 47217 |
| 31.5 | 963 | 1655 | 9194 | 52009 | 29030 | 2042 | 16279 | 32355 |
| 32 | 593 | 1531 | 8266 | 35649 | 21962 | 2042 | 9354 | 28357 |
| 32.5 | 395 | 1184 | 7297 | 23496 | 13919 | 1252 | 6241 | 20319 |
| 33 | 247 | 549 | 5092 | 15540 | 12307 | 922 | 4028 | 13088 |
| 33.5 | 148 | 340 | 3888 | 6407 | 5632 | 725 | 2446 | 7837 |
| 34 | 99 | 275 | 1748 | 4536 | 2810 | 329 | 887 | 5424 |
| 34.5 | 25 | 79 | 1374 | 1683 | 1541 | 264 | 780 | 2263 |
| 35 | 0 | 85 | 436 | 1473 | 996 | 99 | 429 | 990 |
| 35.5 | 25 | 39 | 261 | 635 | 374 | 0 | 215 | 744 |
| 36 | 0 | 0 | 187 | 48 | 106 | 0 | 0 | 280 |
| 36.5 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 183 |
| ALL | 12494 | 28323 | 290408 | 828721 | 734610 | 19893 | 208293 | 1003396 |
| No. of samples | 1 | 3 | 5 | 14 | 11 | 1 | 8 | 22 |
| Σ sample weight | 8.1 | 22.3 | 30.1 | 99.5 | 59.0 | 9.2 | 63.3 | 191.6 |
| Corresp. catch | 200 | 429 | 3008 | 10112 | 8325 | 303 | 3432 | 11515 |

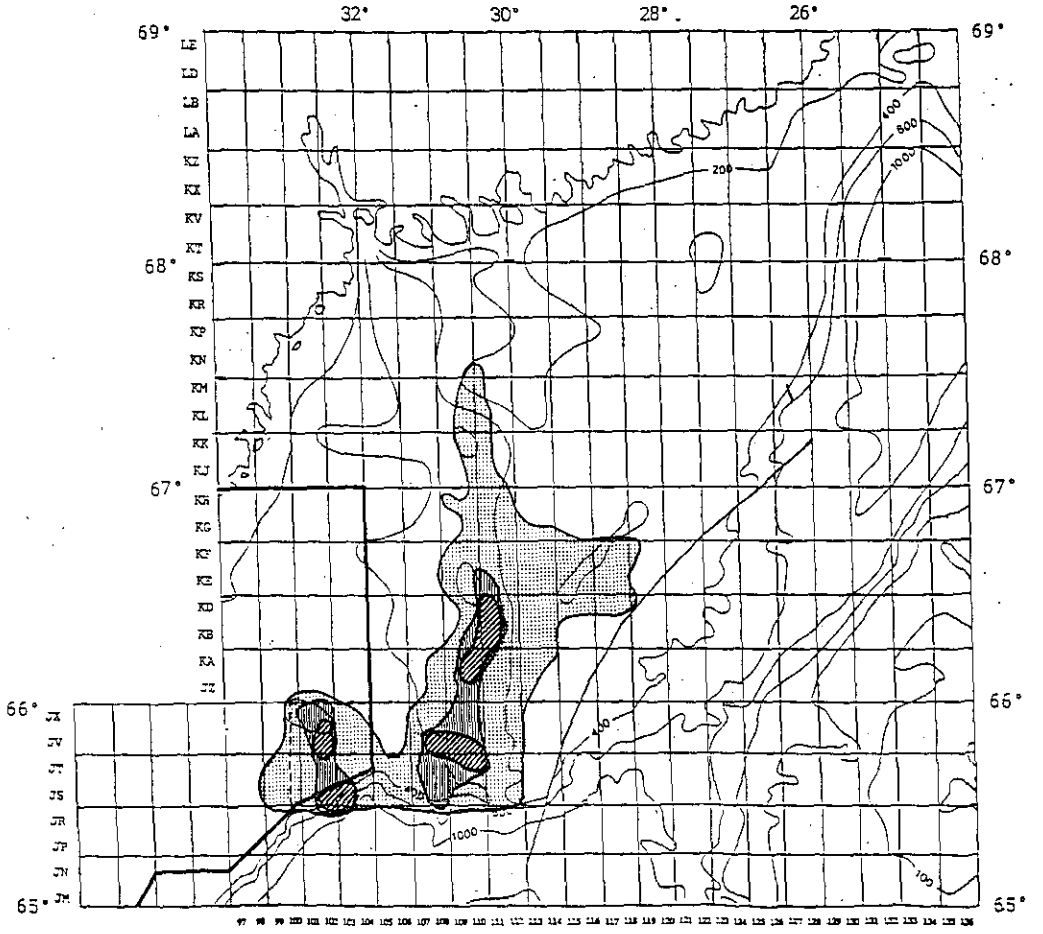


Figure 1. Distribution of catches of shrimp (tons per statistical unit) in the fishery in Denmark Strait in 1990, based on logbooks from the Greenland Fishery. The solid line shows the northern extension of the 'redfish-box' (see text), and the broken line the area opened to the shrimp fishery from March 1990.

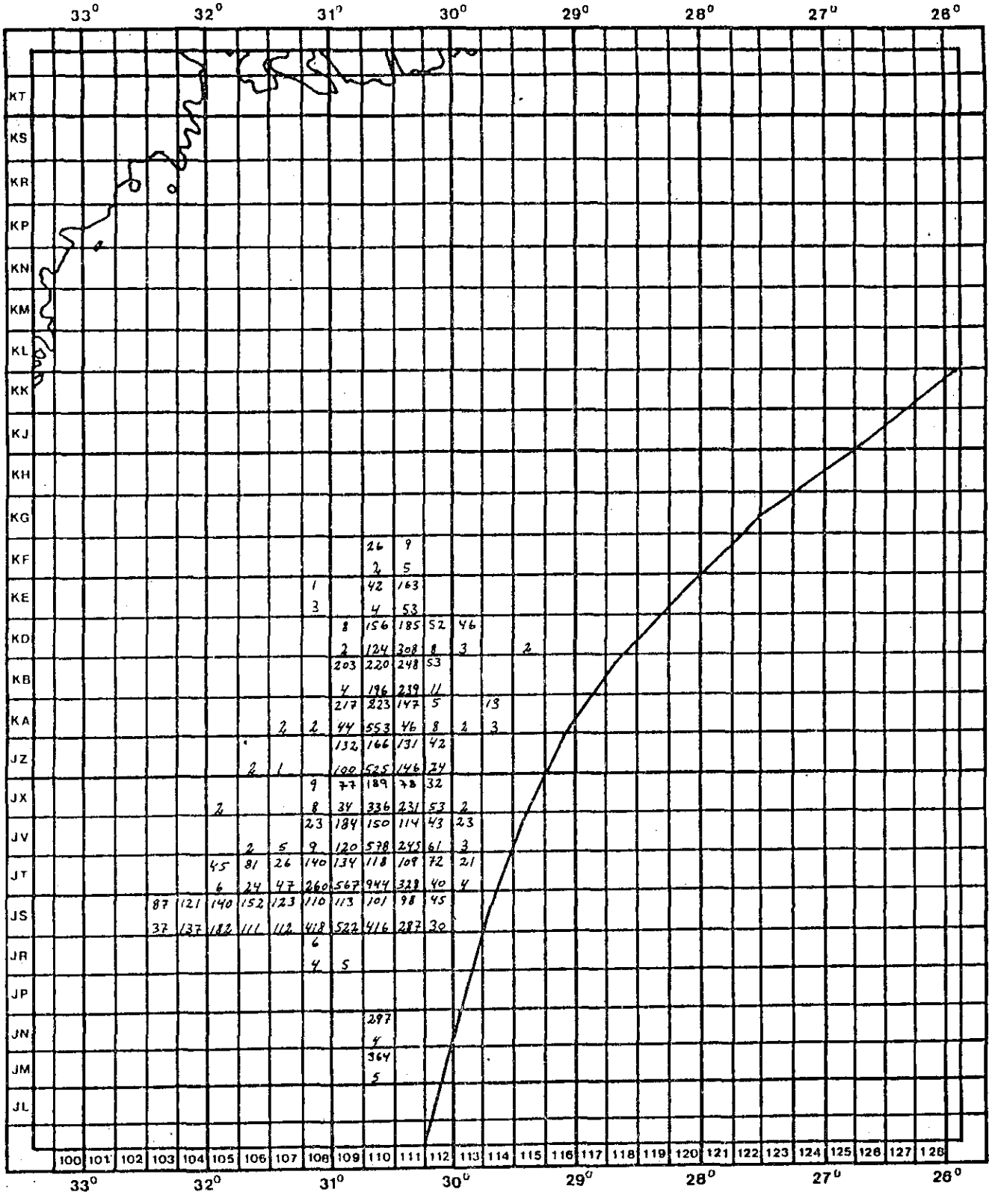


Figure 2. Distribution of mean catch of shrimp (kg/hour) and effort (hours) the shrimp fishery in Denmark Strait in January 1990, based on logbo information from the Greenland fishery.

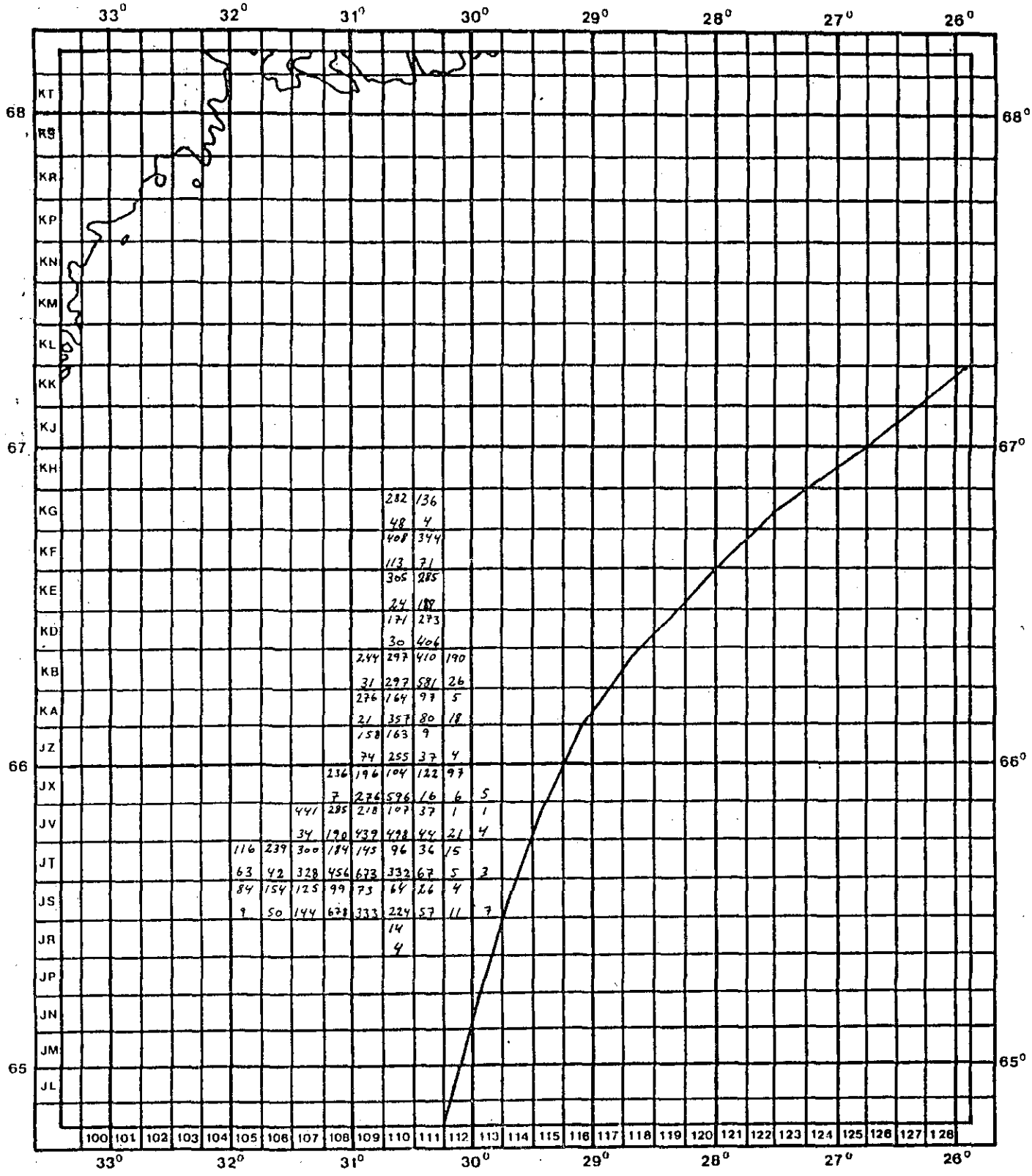


Figure 2 continued. Data from February 1990.

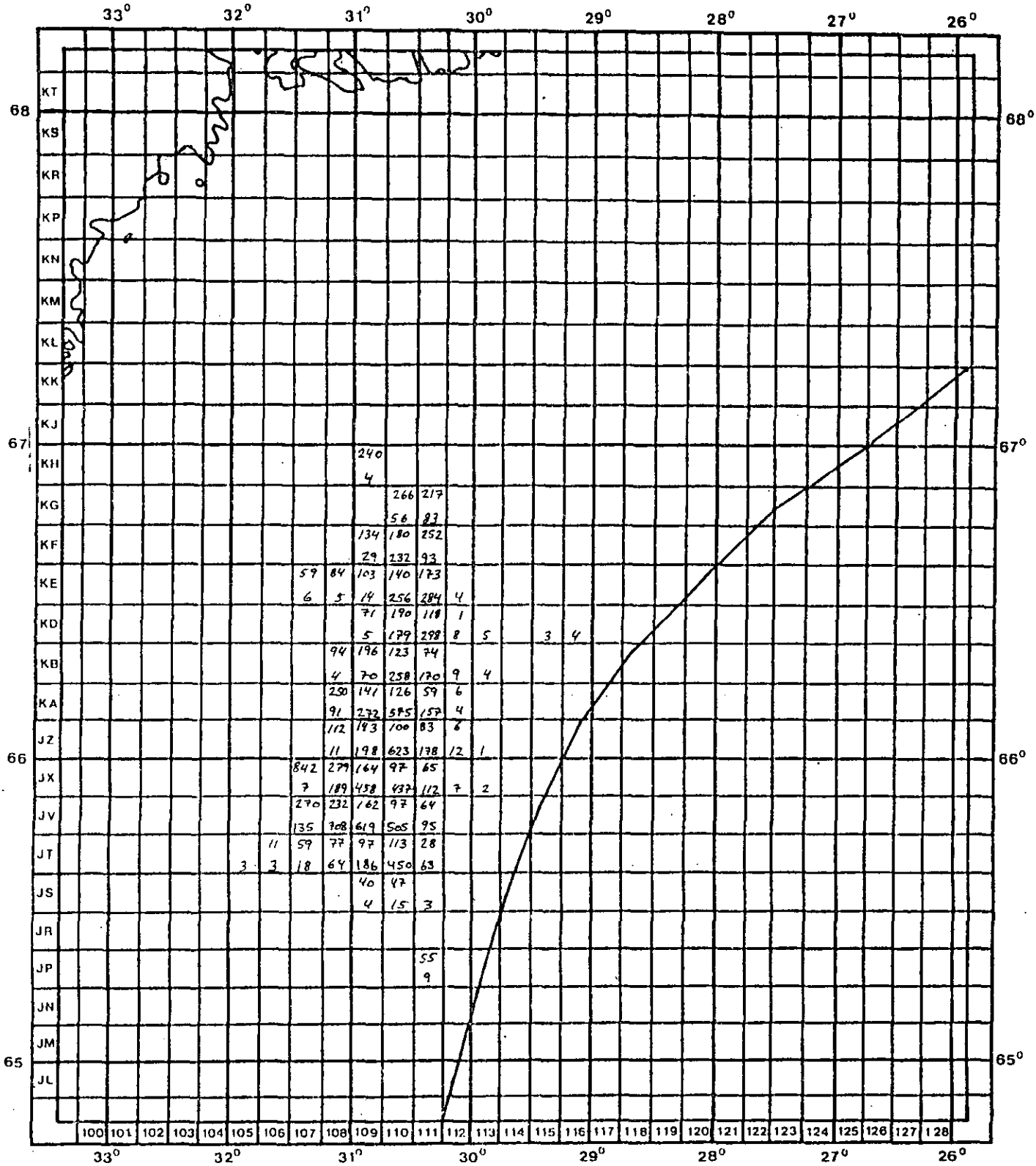


Figure 2 continued. Data from March 1990.

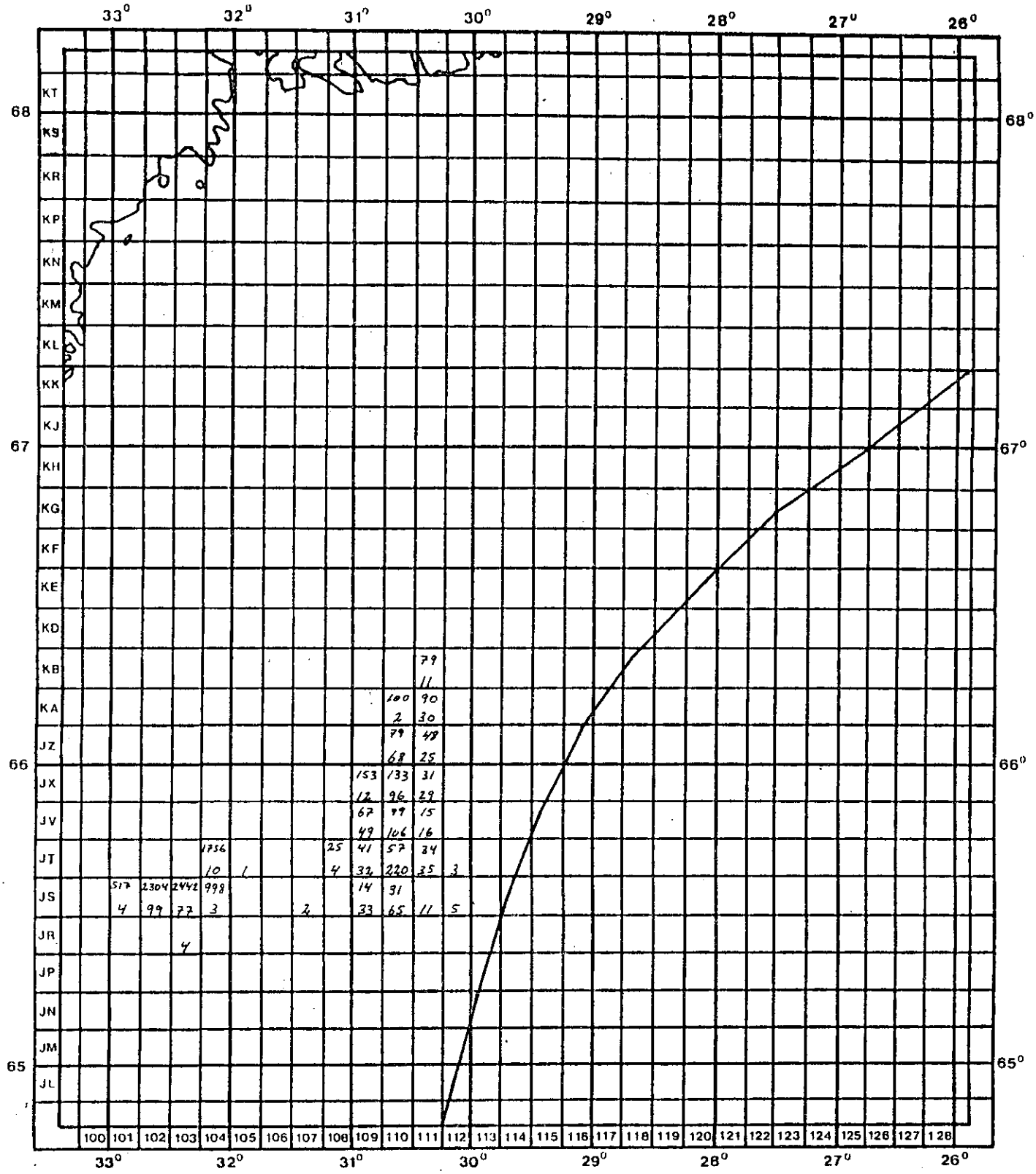


Figure 2 continued. Data from April 1990.

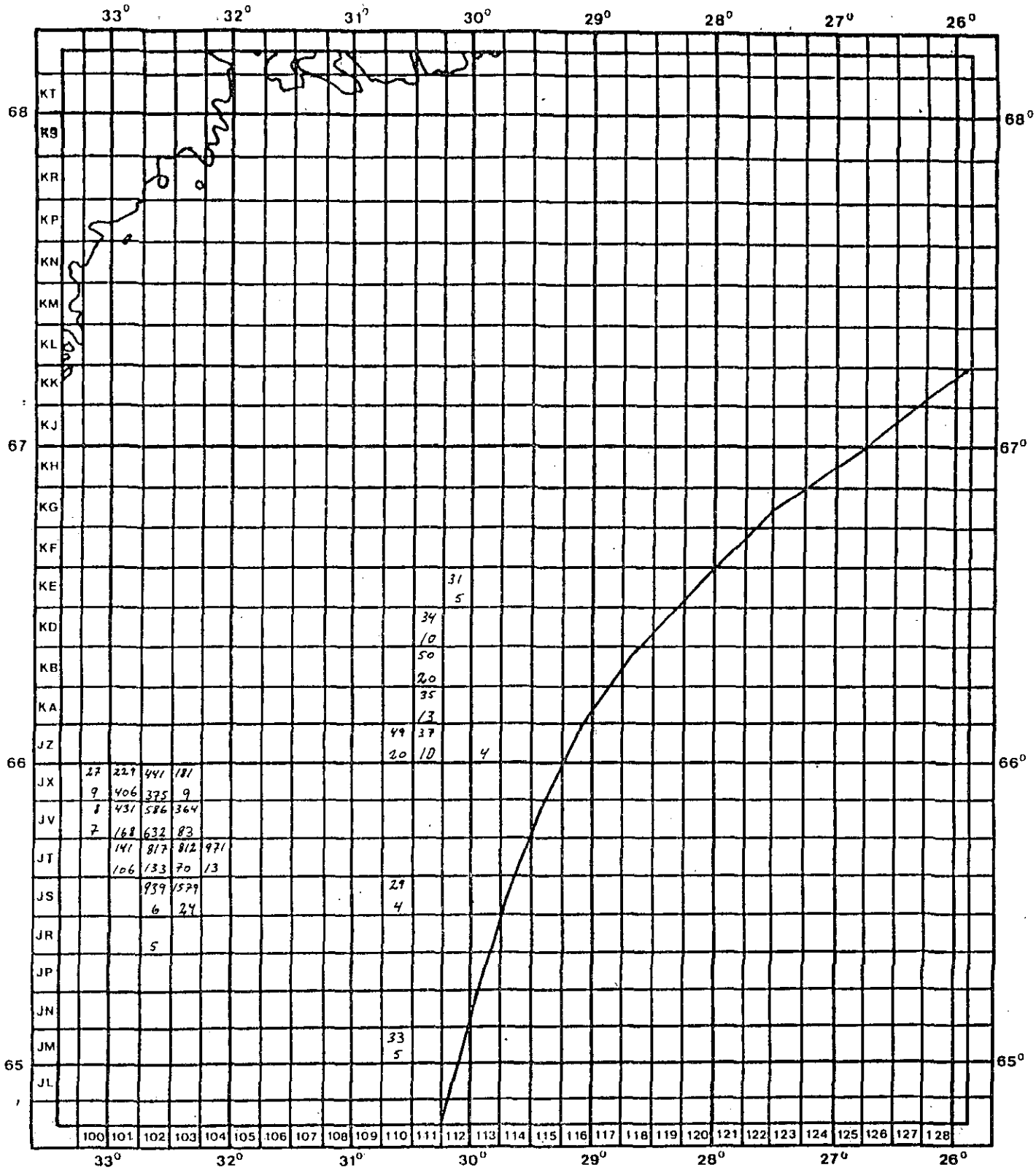


Figure 2 continued. Data from May 1990.

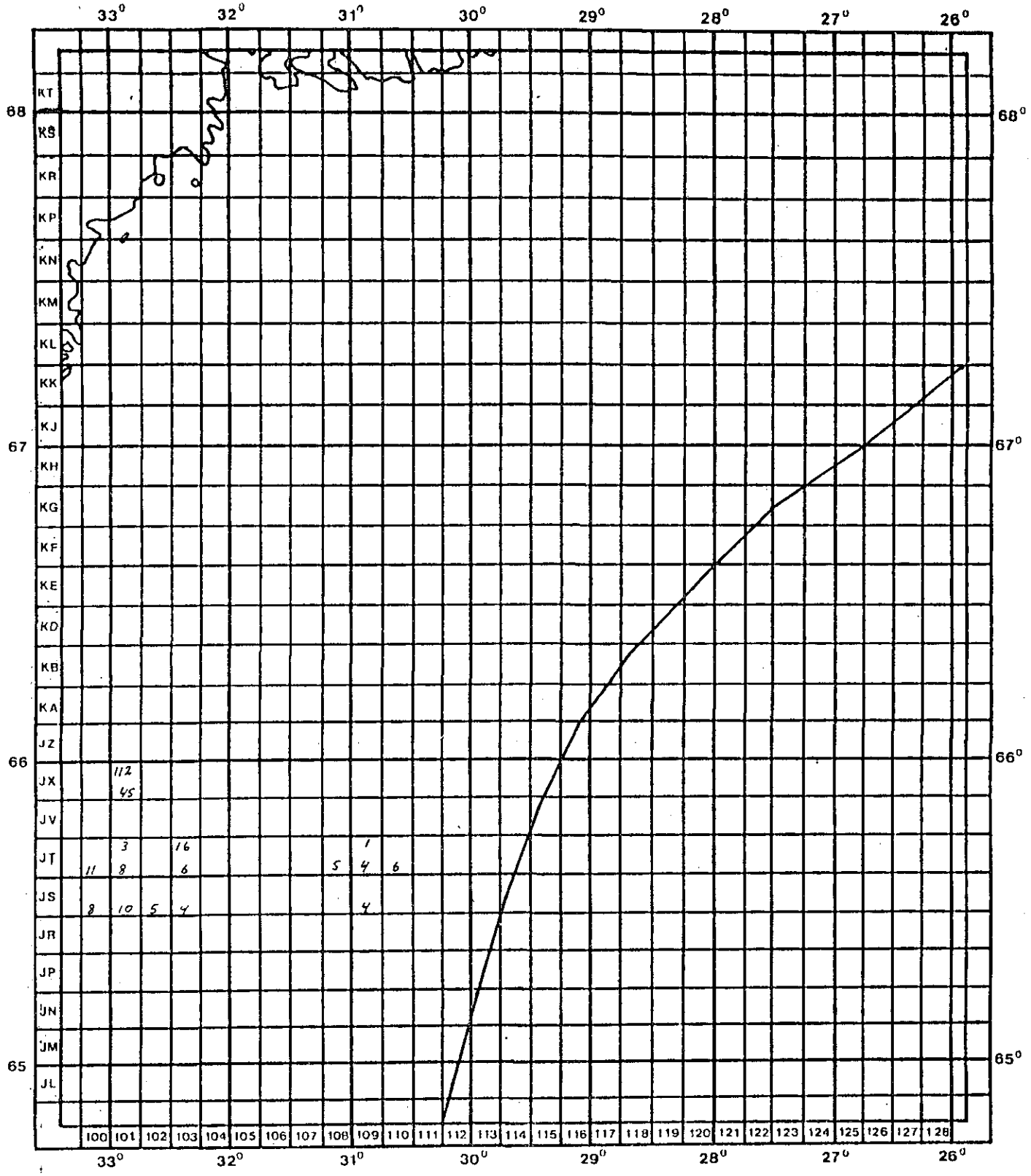


Figure 2 continued. Data from June 1990.

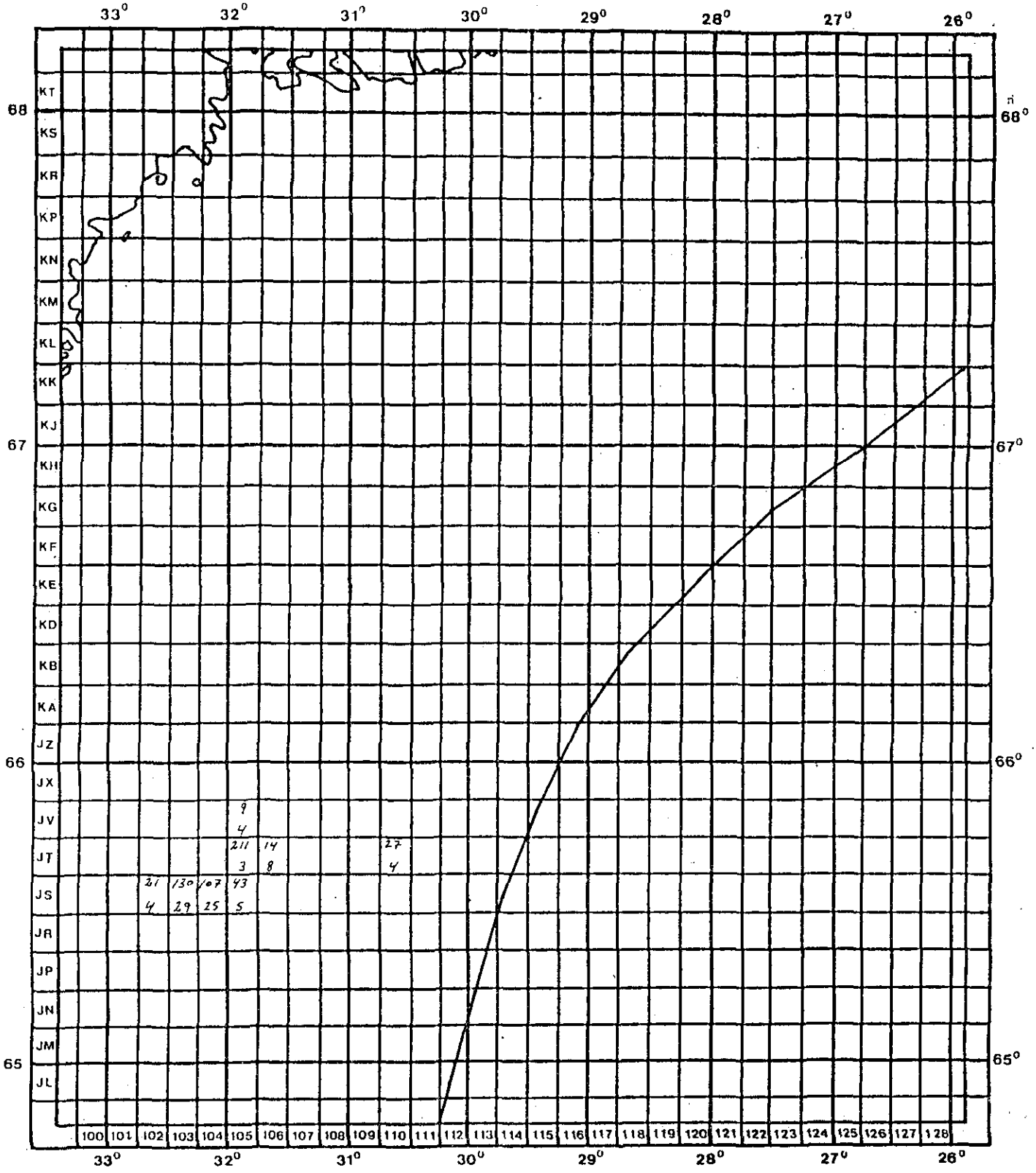


Figure 2 continued. Data from July 1990.

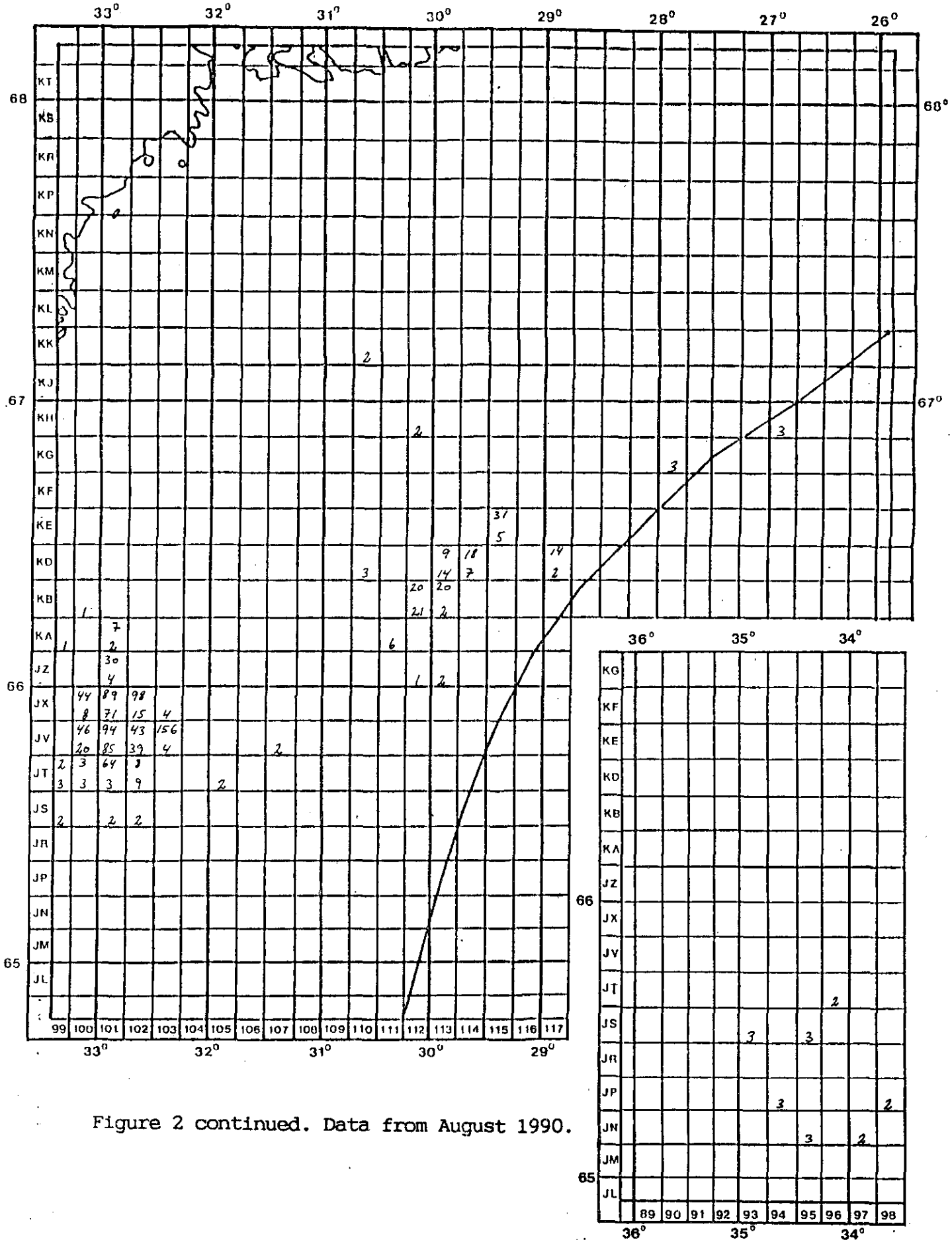


Figure 2 continued. Data from August 1990.

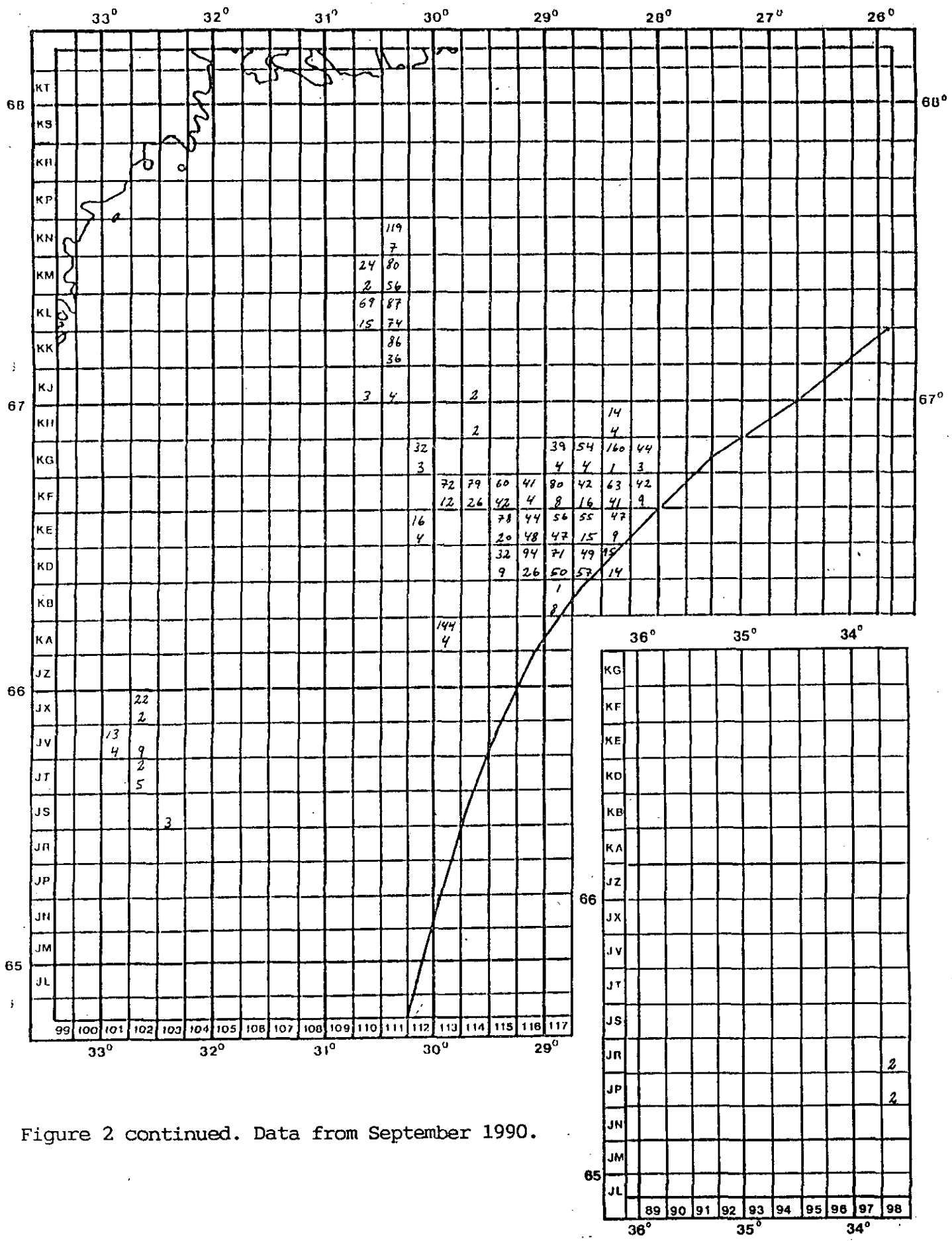


Figure 2 continued. Data from September 1990.

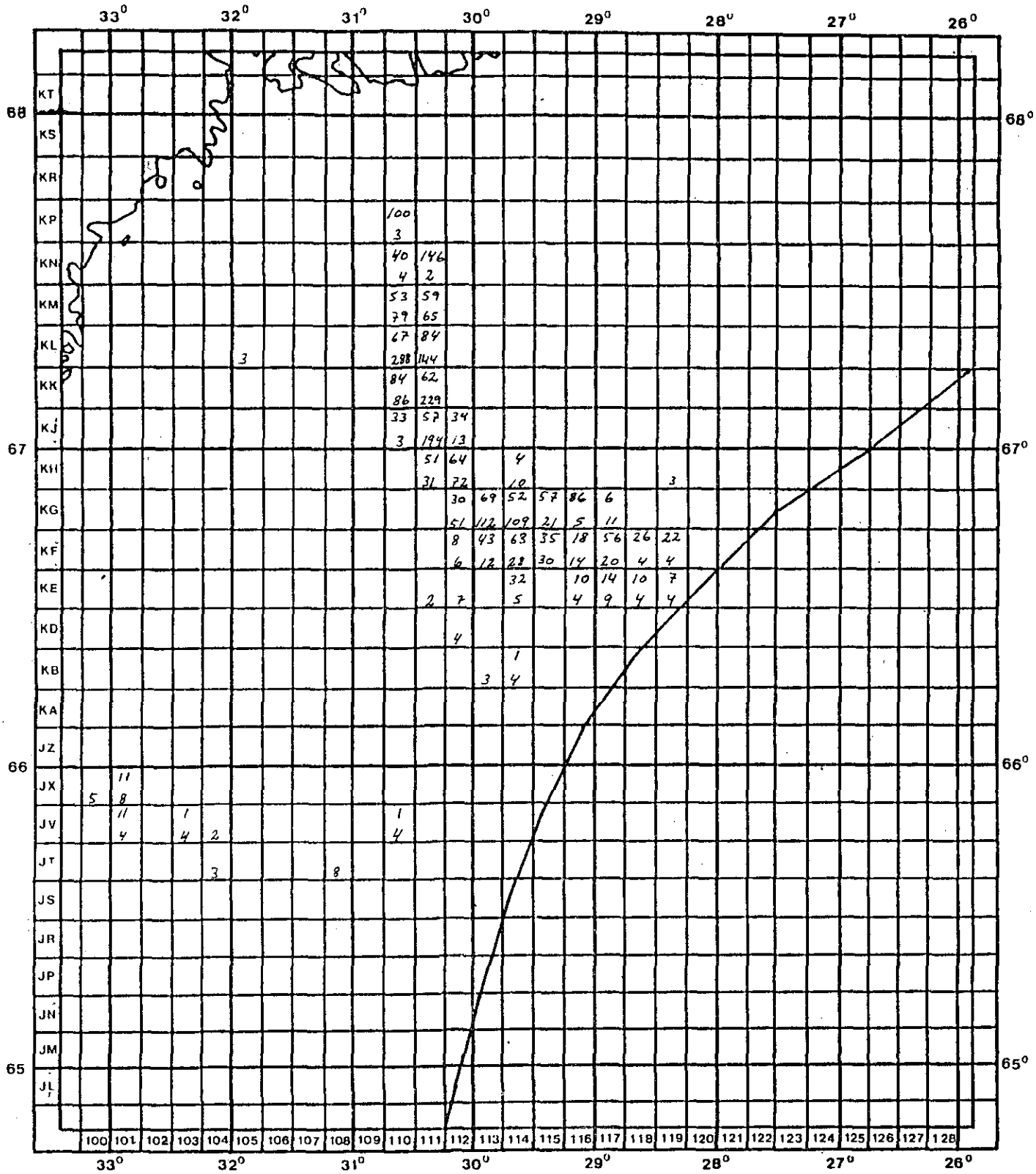


Figure 2 continued. Data from October 1990.

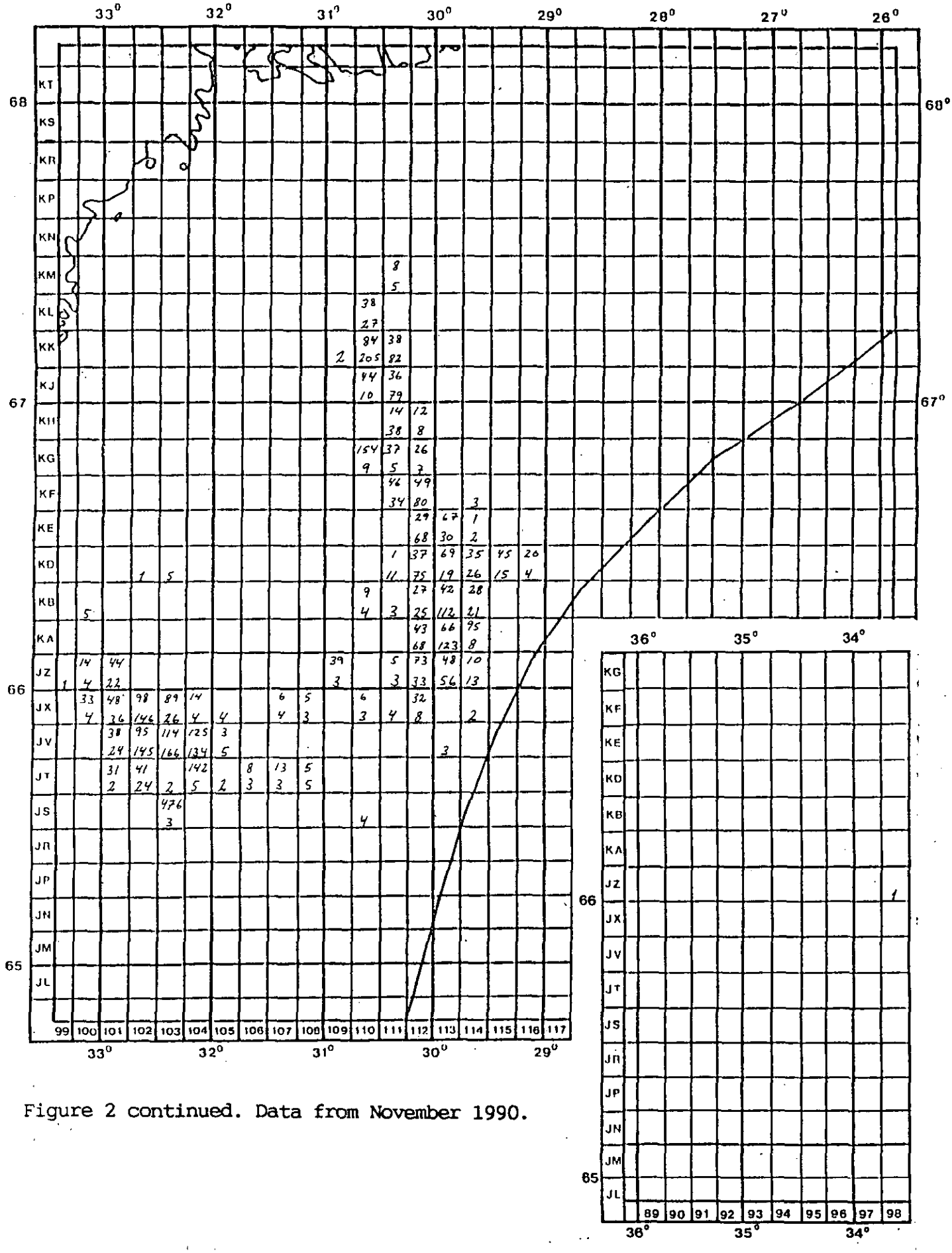


Figure 2 continued. Data from November 1990.

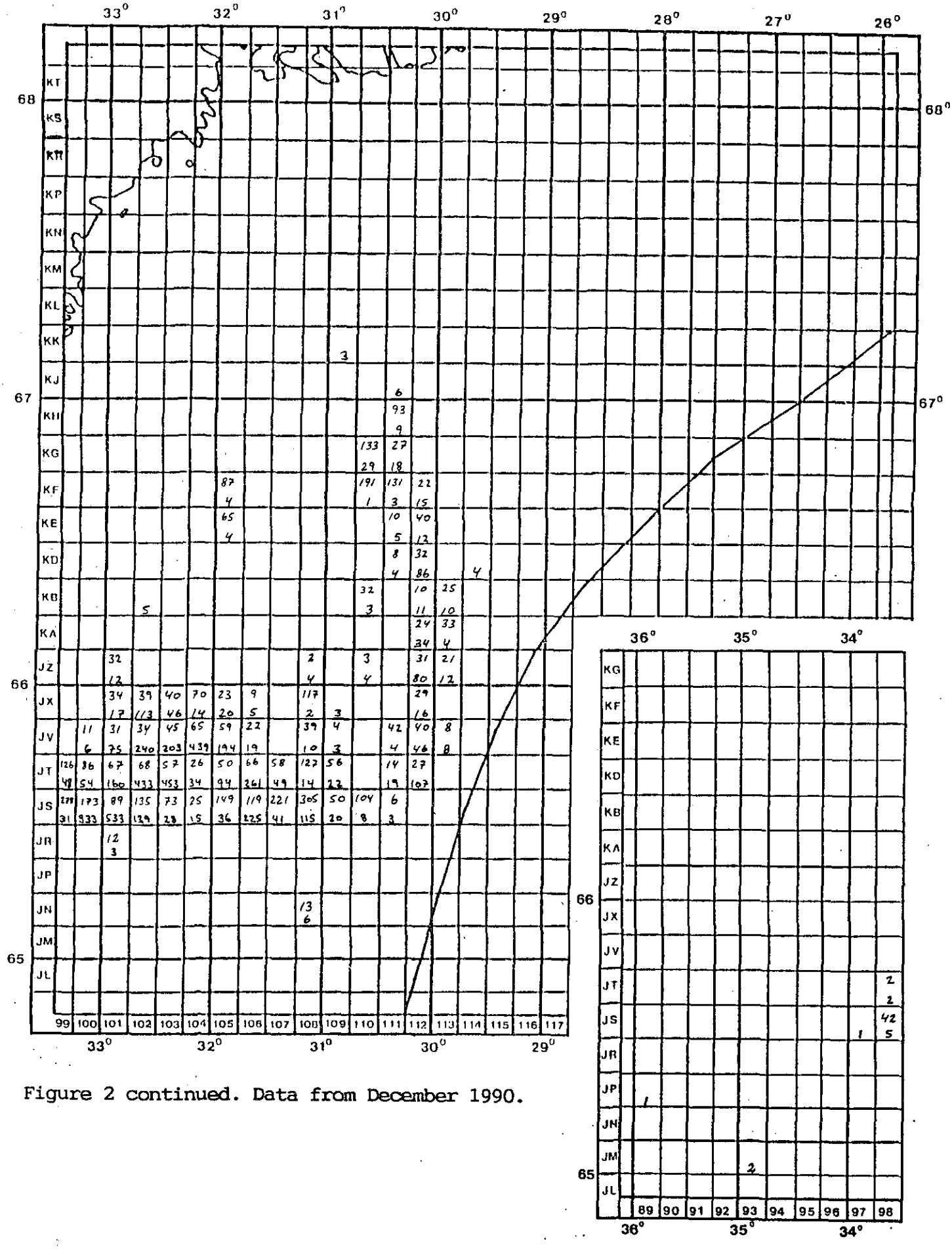


Figure 2 continued. Data from December 1990.

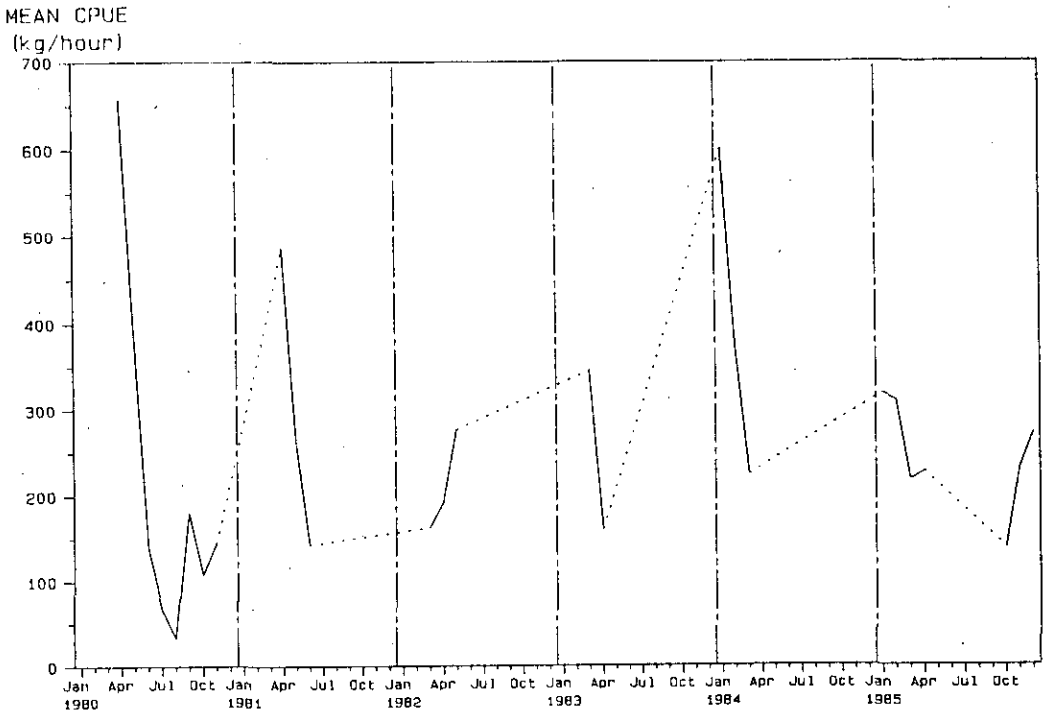


Figure 3a. Monthly mean catch rates of shrimp (kg/hour) in the main fishing area in Denmark Strait from April 1980 to December 1985, based on logbook information from the Greenland fishery (and in 1980-82 also in the Danish fishery).

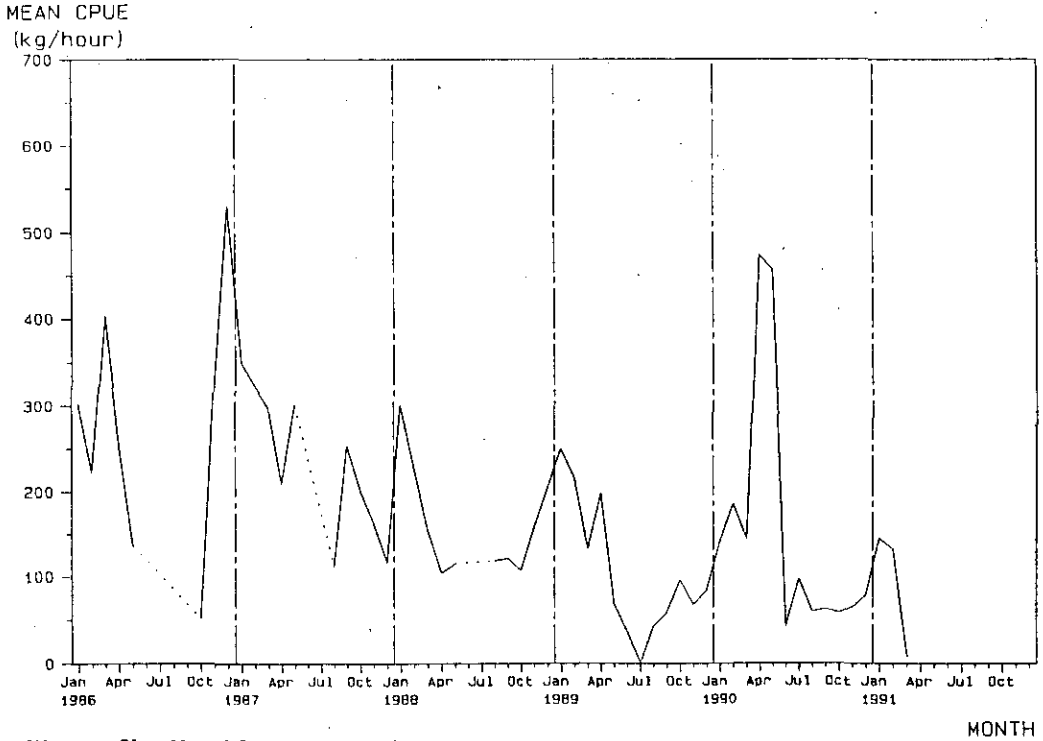


Figure 3b. Monthly mean catch rates of shrimp (kg/hour) in the main fishing area in Denmark Strait from January 1986 to March 1991, based on logbook information from the Greenland fishery.

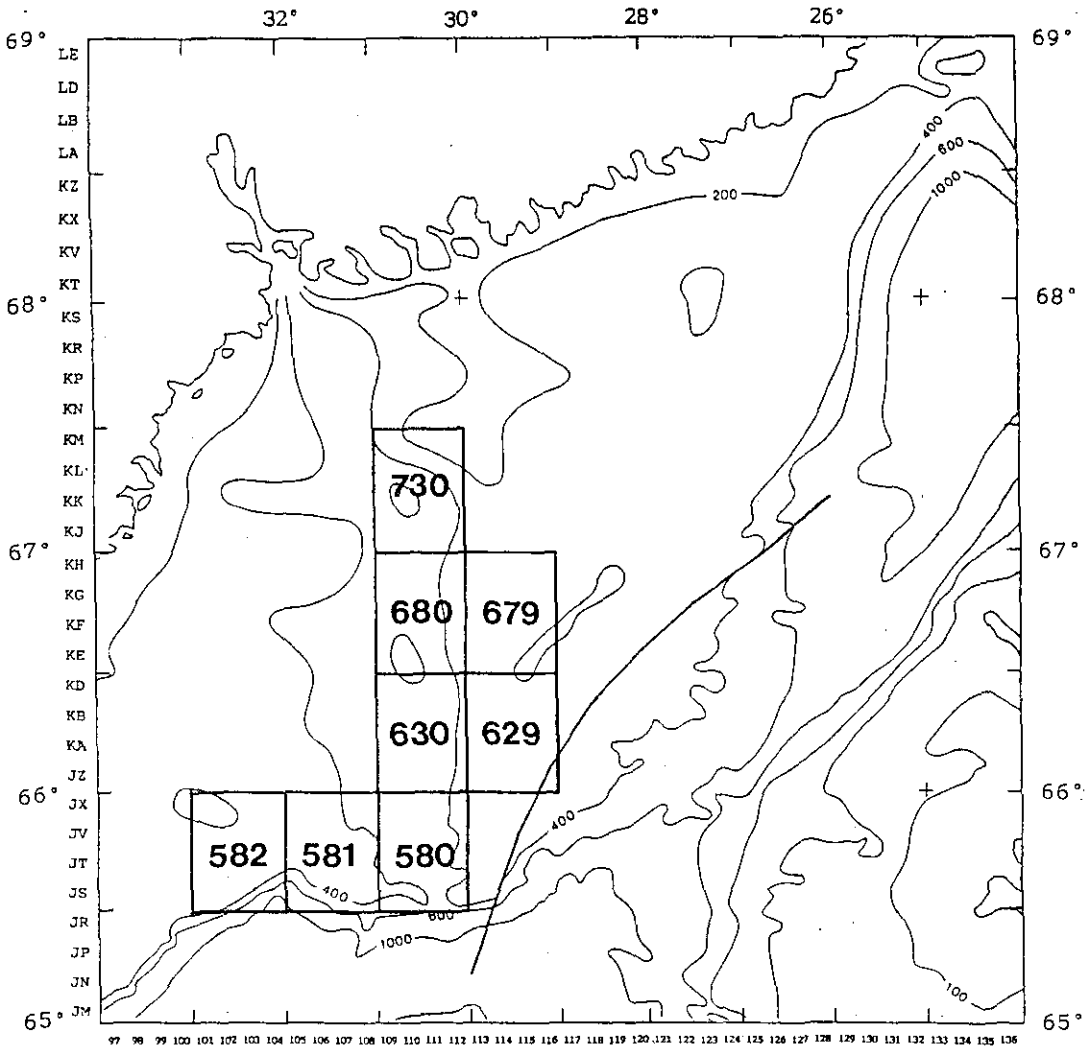


Figure 4. Map showing numbering of statistical units (Iceland system) from which samples have been collected.

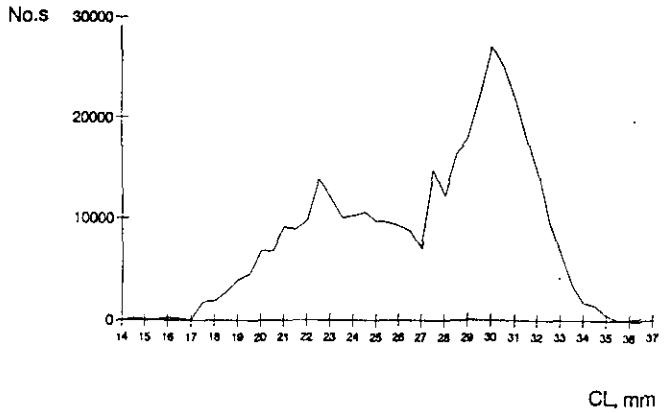


Figure 5. Pooled shrimp samples (weighted by catch) from statistical unit no. 580 (see Fig. 4) in April 1990.

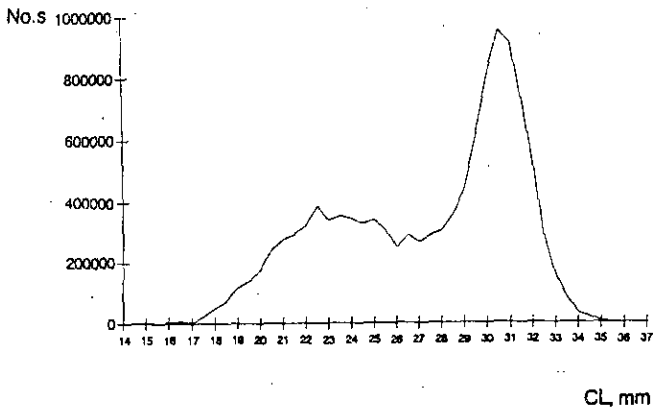


Figure 6. Pooled shrimp samples (weighted by catch) from statistical unit no. 582 (see Fig. 4) in April 1990.

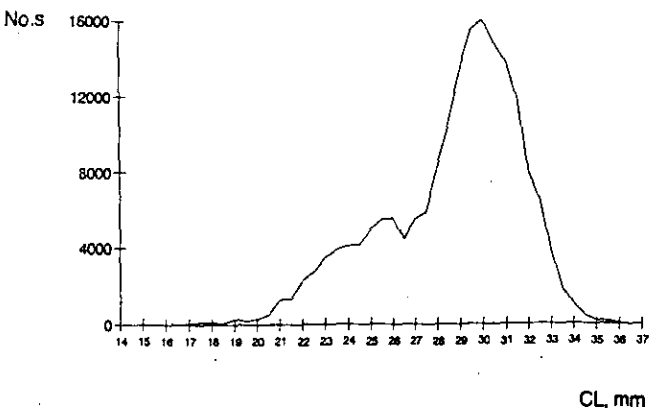


Figure 7. Pooled shrimp samples (weighted by catch) from statistical unit no. 629 (see Fig. 4) in October 1990.

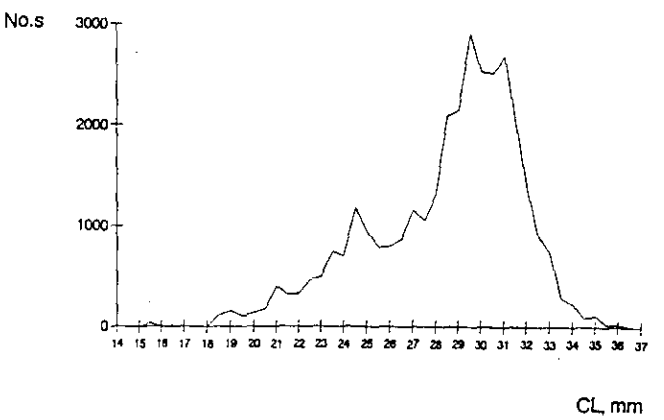


Figure 8. Pooled shrimp samples (weighted by catch) from statistical unit no. 630 (see Fig. 4) in October 1990.

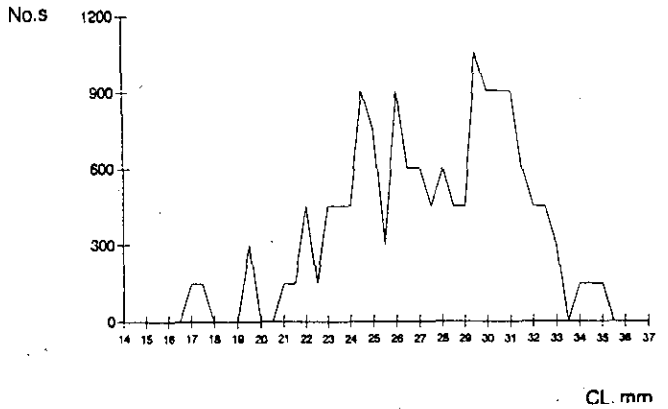


Figure 9. Pooled shrimp samples (weighted by catch) from statistical unit no. 679 (see Fig. 4) in October 1990.

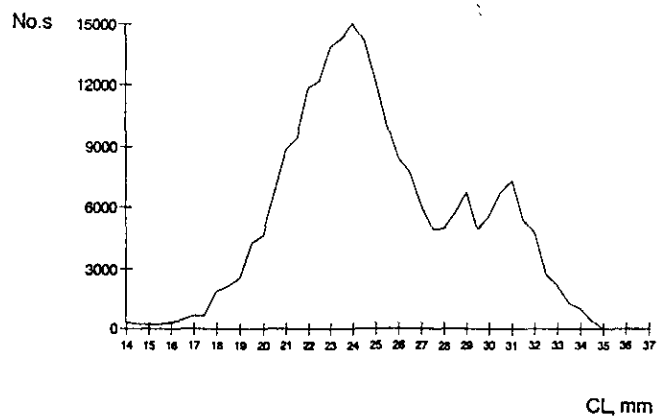


Figure 10. Pooled shrimp samples (weighted by catch) from statistical unit no. 680 (see Fig. 4) in October 1990.

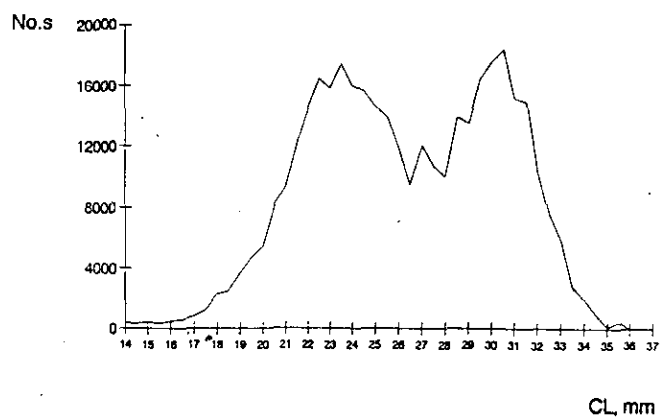


Figure 11. Pooled shrimp samples (weighted by catch) from statistical unit no. 730 (see Fig. 4) in October 1990.

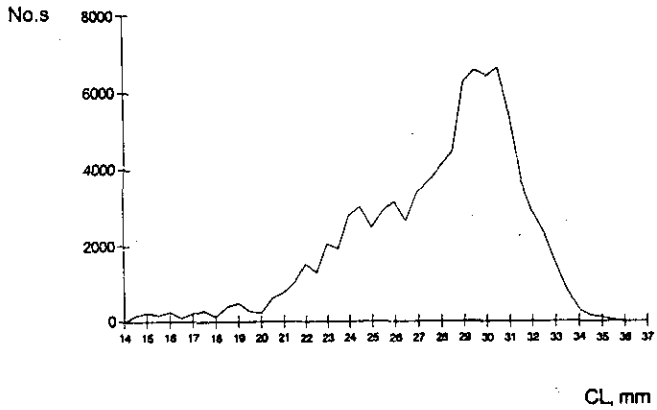


Figure 12. Pooled shrimp samples (weighted by catch) from statistical unit no. 629 (see Fig. 4) in November 1990.

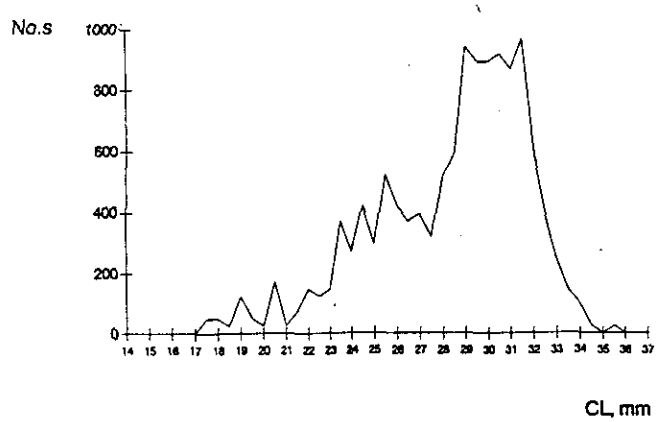


Figure 13. Pooled shrimp samples (weighted by catch) from statistical unit no. 630 (see Fig. 4) in November 1990.

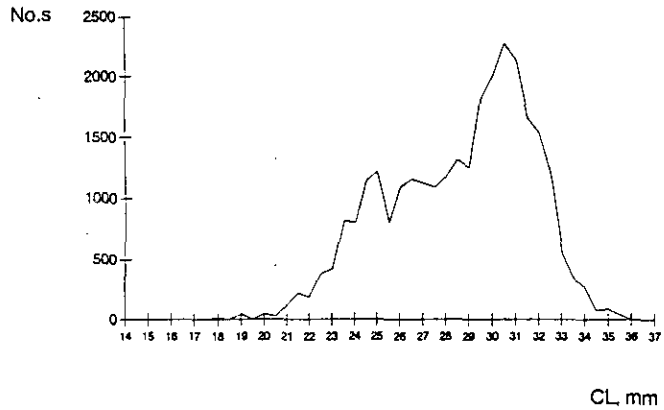


Figure 14. Pooled shrimp samples (weighted by catch) from statistical unit no. 679 (see Fig. 4) in November 1990.

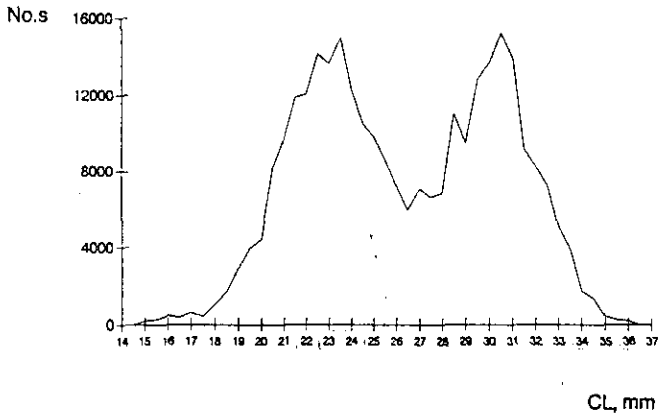


Figure 15. Pooled shrimp samples (weighted by catch) from statistical unit no. 580 (see Fig. 4) in January 1991.

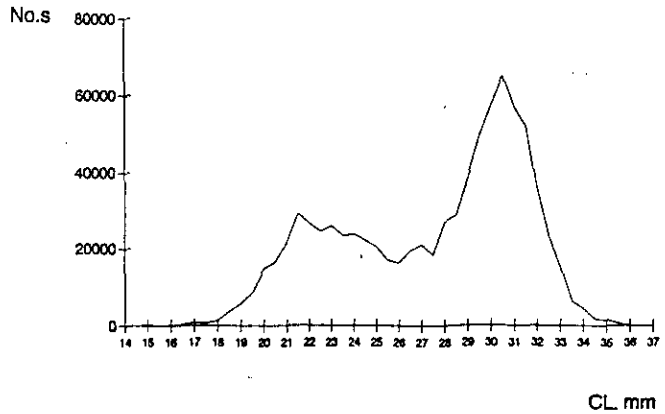


Figure 16. Pooled shrimp samples (weighted by catch) from statistical unit no. 581 (see Fig. 4) in January 1991.

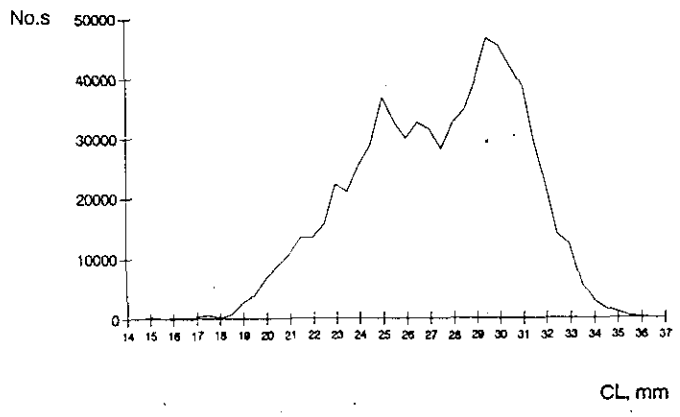


Figure 17. Pooled shrimp samples (weighted by catch) from statistical unit no. 582 (see Fig. 4) in January 1991.

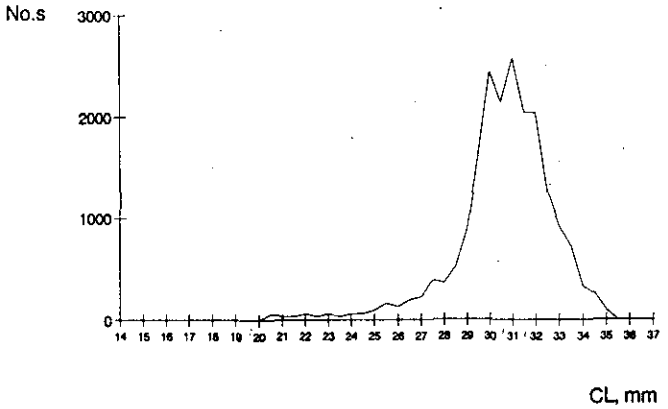


Figure 18. Pooled shrimp samples (weighted by catch) from statistical unit no. 580 (see Fig. 4) in February 1991.

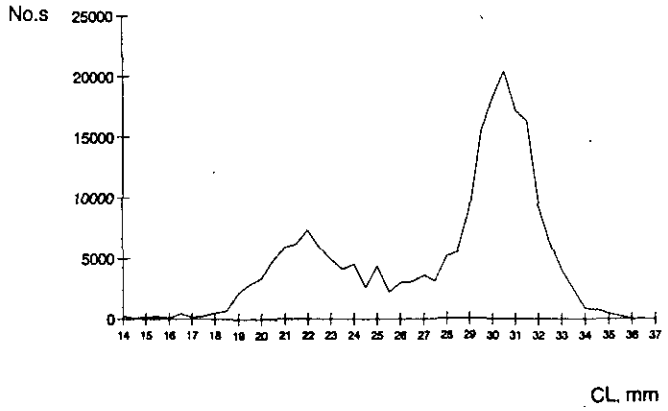


Figure 19. Pooled shrimp samples (weighted by catch) from statistical unit no. 581 (see Fig. 4) in February 1991.

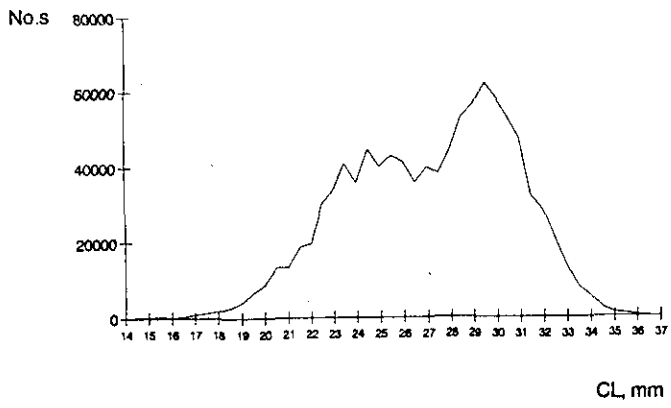


Figure 20. Pooled shrimp samples (weighted by catch) from statistical unit no. 582 (see Fig. 4) in February 1991.