PRELIMINARY RESULTS OF THE 1985 EASTERN BERING SEA CRAB SURVEY AND THE CURRENT STATUS OF CRAB STOCKS

Report To: North Pacific Fishery Management Council, The Alaska Board of Fisheries, and U.S. Section of the International North Pacific Fisheries Commission

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THE SURVEY

The 1985 Eastern Bering Sea crab survey consisted of 358 successful trawl tows and covered an area of approximately 132,000 square nautical miles. The 1985 survey area was slightly larger than that of 1984 and covered the Bering Sea ranges of all commercially exploited crab stocks except for *Chionoecetes opilio*. Unexploited *C. opilio* stocks extend to the north of the survey area. Golden king crab were not surveyed.

The survey was conducted aboard two chartered vessels, the F/V Argosy and the University of Washington R/V Alaska between June 6 and September 3. Methodology was similar to that of previous surveys in that most tows were made at the centers of squares defined by a 20 x 20 nautical mile grid. Near St. Matthew Island and the Pribilofs, additional tows were made at the corners of squares. Lacking data to the contrary, we assumed that the trawls behaved similarly to those used in previous years. Procedures for estimating abundance were identical to those of previous years.

Note that crab sizes are reported as carapace length (cl) for king and hair crabs, and carapace width (cw) for tanner crabs.

STATUS OF STOCKS

Red King Crab. Legal male crabs were sparsely distributed in Bristol Bay and their distribution also extended into the Northern District (North of 58°39', Fig. 1). In Bristol Bay, the 1985 distribution extended about 60 miles further west than in 1984. A few red king crabs were also found near the Pribilof Islands but their contribution to overall abundance in the eastern Bering Sea is negligible. Estimated mean abundances of pre-recruit and legal males decreased by 17% and 14% respectively, relative to 1984 (Table 1), but these estimates are not statistically significantly different. Thus, abundance of male crabs seems to be stable. The dominant mode (70-90 mm cl) that occurred in 1984 size-frequency data (Fig. 2) did not appear in 1985. However, since the 1984 mode reflected crabs taken in only five tows, it may have been an artifact. The 1985 catches had less variance than those of 1984. Abundance of juvenile crabs decreased significantly, as shown by the lack of crabs in the 50-70 mm cl range. Thus, future recruitment of adult crabs to the fishery will probably continue to decline for the next 3-4 years.

The abundance of mature (>90 mm cl) females in Bristol Bay decreased significantly by 61% from 17.6 to 6.8 million crabs. The abundance of immature females decreased significantly also, from 57.6 to 6.9 million. Again, the accuracy of last year's estimate is questionable. Virtually all mature females were ovigerous with 85% carrying full egg clutches. There were at least three times as many mature males as mature females,

implying a high probability that the majority of mature females will be fertilized during the 1986 breeding period. The decline in overall abundance does not appear to have affected the capacity for full reproduction within the population, although most of the mature females are small (85-110 mm cl).

The fishery will be opened on September 25, 1985 with a guideline harvest of 3.0 to 5.0 million pounds relative to an estimated stock of 12.5 ± 3.2 million pounds (95% confidence intervals, i.e. 9.3 to 15.7 million lbs) in Bristol Bay (Area T). Harvests are expected to be in the middle portion of the guideline harvest range and relationships between estimated abundance and catch per pot-lift suggest that the fleet average will be three to four crabs per pot-lift (Fig. 3).

As of September 7, the accumulated 1985 incidental catch of king crabs by joint venture and foreign bottomfish trawlers in the Bering Sea was over one million crabs. This estimate is much greater than in 1984, and represents over 2.5% of the estimated 1985 king crab population. Size frequency data for these incidentally caught crabs are not yet available.

Pribilof Islands Blue King Crab. Legal males were found primarily to the northeast of the islands (Fig. 4). Although the estimated mean abundances of pre-recruit and legal males declined by 45 and 47 percent respectively, relative to 1984 (Table 1), these differences are not statically significant. Even so, the estimates are now at an historic low. Size-frequency data show declines in almost all segments of the population over the past

four years (Fig. 5). However, size-frequency data have shown some crabs less than 30 mm in 1983, 1984 and 1985. Crabs in this size range were never taken in the survey prior to 1983, and their occurrence may indicate highly successful larval settlement. In order to collect better data on this phenomenon, a 4-day special study was conducted at St. Paul Island in September of 1985, but the data have not yet been analyzed.

The abundance of mature (>90 mm cl) females declined significantly from 3.1 to 0.5 million crabs. However, estimates of female abundance are the least accurate, due to their preference for rocky habitat which is not sampled well by trawls. Approximately 50% of the mature females were barren, but this is a normal occurrence in blue king crab due to their biennial spawning cycle (D. Somerton and R. MacIntosh, 1985, J. Crustacean Biol. 5:365-376).)

The 1984 fishery produced 307,000 pounds landed by 16 vessels with an average of 3 crabs per pot lift. The 1985 fishery will open September 25 with a guideline harvest of 0.3 to 0.9 million pounds as compared with an estimated 1.9 (±0.9) million pounds of legal stock. Relationships between estimated abundance and catch rates suggest that the fleet average will be less than one crab per pot-lift (Fig. 6). However, the 1984 catch-per-unit-effort (CPUE) of 3 crabs/pot was greater than predicted, perhaps because of the greatly reduced effort. Estimates of incidental catch are not available for 1985 but have been less than 50,000 crab in previous years for the combined Pribilof and St. Matthew Island areas.

St. Matthew Island Blue King Crab. Legal males occur primarily south and west of the island (Fig. 4). Although 1985 catches of legal male crabs were similar to 1984, the area over which they were distributed was reduced in 1985. The estimated abundances of pre-recruit and legal crabs have been declining over the past three years (Table 1). Over the past year, mean pre-recruit abundance declined by 42% and legal abundance declined by 31% although again, these differences were not statistically significant. No adult females were encountered by the survey, probably because they occur almost exclusively in rocky nearshore habitat. Juvenile (<90 mm) abundance was similar to 1984. Size-frequency data show the passage of a single large modal group of males through the fishery and indicate that the population will continue to decline (Fig. 7). Similar to the Pribilof Islands population, there are indications of successful larval settlement over the past two or three years.

The 1985 fishery opened on September 1 with a guideline harvest of 0.9-1.9 million pounds, and 79 vessels participated. Preliminary Alaska Department of Fish and Game (ADF&G) statistics indicate that over 2.4 million pounds were landed in a one-week season with an average weight of about 5.0 pounds and an average CPUE of 10 crabs per pot-lift. The estimated exploitation rate was 47%, or about 480,000 crabs out of an estimated legal stock of 1.1 million crabs. This harvest rate was in accordance with Board and Council guidelines established in March 1984 that allowed for a liberal harvest if the legal stock was composed largely of post-recruit crab (see Fig. 7). In comparison, during

1984, 90 vessels landed 3.8 million pounds or 840,000 crabs for an estimated exploitation rate of 53% and an average CPUE of 11 crabs per pot-lift. There are no separate estimates of incidental catch for the St. Matthew Island population, and little trawling occurs on these grounds.

Tanner crab (*C. bairdi*). Legal males were sparsely distributed in Bristol Bay and continental slope areas with an area of relatively high abundance in inner Bristol Bay (Fig. 8). The distribution was essentially identical to that of 1984. The estimated abundances of pre-recruit and legal male *C. bairdi* have been declining since 1975 and are now at an historic low (Table 2). Over the past year the estimated abundance of legal crabs declined by 23% (not significant), whereas the estimated abundance of pre-recruits declined by a significant 56%. The abundance of large mature (>85 mm cw) females declined signifcantly from 33.4 million in 1984 to 15.9 million in 1985 (-52%). Approximately 90% of the mature females were gravid, similar to 1984. Size-frequency data show that continued declines may be expected (Fig. 9). A trough in the size-frequency distribution at 70 to 90 mm cw is particularly ominous and probably indicates that the legal stock will reach an all-time low in three to four years. However, even the juveniles in the 30-50 mm cw range which were abundant in 1983-84 have declined greatly.

According to preliminary ADF&G statistics, as of September 13, 1985, the 1985 fishery produced 3.2 million pounds landed by 41 vessels with an average catch of 8 crabs per pot-lift. This

is an improvement over 1984, when 41 vessels landed 1.2 million pounds at 8 crabs/pot-lift. However, landings and catch rates are still at historically low values. In 1984, catch rates for *C. bairdi* were too low to attract a directed fishery, so little effort was targeted on *C. bairdi*; most vessels targeted on *C. opilio* in areas where *C. bairdi* were scarce or absent. There will be an estimated 10.3 (± 3.0) million pounds available during 1986. Relationships between population estimates and catch rates indicate that the 1986 fleet average will be about 6 crabs per pot-lift (Fig. 10). No 1986 guideline harvest levels have been determined. Separate incidental catch rates are not available for individual species of tanner crabs but the incidental catch for both species was approximately 1.2 million crabs as of September 1 while the total population estimate for *C. bairdi* was 119.4 million crab. Historically, *C. opilio* has been the dominant species in the incidental catch.

Tanner Crab (*C. opilio*). The legal size limit for this species is 78 mm cw but they are not currently landed at sizes smaller than 95 mm. Additionally, there are frequently higher prices paid for large (>110 mm) crab. In the following discussion, the designation "pre-recruit" (95 to 109 mm cw) and "large" reflect the fact that crabs smaller than 110 mm were not usually landed prior to 1983. The size of crabs entering the fishery results from market conditions, and both the "pre-recruit" and "large" size categories are currently being landed.

The distribution of large males showed an area of high concentration in a broad band north of the Pribilof Islands (Fig. 11). There were also areas of high abundance in the extreme northwestern portion of the survey area and there are probably some large crab in unsurveyed areas. The distribution of pre-recruits was similar to that of large males except that their areas of highest abundance were slightly to the north. There has been very little fishing north of 58° and estimates of abundance (Table 2) probably reflect availability to the fishery even though an unknown portion of the commercially exploitable stock may be north of the survey area. The estimated mean abundance of both pre-recruit and large male *C. opilio* declined significantly over the past year. Combining all districts, the abundance of pre-recruits decreased from 170.4 to 67.4 million crabs (-60%) and the abundance of large males decreased from 74.0 to 40.7 million crabs (-45%). Size-frequency data indicate the passage of one or two large modal groups through the fishery and indicate declining recruitment over the next two to three years (Fig. 12). Recruitment patterns in this stock are not entirely clear since recruitment evidently occurs both through localized production and by immigration.

The 1985 fishery closed prior to the opening of the St. Matthew Island blue king crab fishery on September 1. Preliminary 1984 ADF&G statistics show participation by at least 58 vessels, landings of about 56 million pounds and average catch rates ranging from 111 crabs per pot-lift in the Northern District to 177 crabs/pot-lift in the Pribilof District.

Currently there is an estimated 129 (± 17.5) million pounds of exploitable stock (>95 mm cw) within the survey area. Comparative fishery statistics for 1984 were 52 vessels landing 24.0 million pounds with an average catch rate of 138 crabs per pot. Relationships between catch rates and population estimates indicate the catch rates in 1986 could be in excess of 90 crabs per pot (Fig. 13). No guideline harvests for 1986 have been determined.

Incidental catch of *C. opilio* is insignificant relative to an estimated total population of 1004.3 million crabs.

Korean Hair Crab. The distribution of hair crab shows a major area of relatively high abundance surrounding the Pribilof Islands and a second area immediately north of the Alaska Peninsula (Fig. 14). The abundance of hair crabs has been declining since 1981 (Table 3); however, a 24% decline in the estimated abundance of large crabs (from 2.9 to 2.2 million, all districts combined) over the past year was not significant. Size-frequency data show a single mode in all years (Fig. 15) and provide little information on recruitment trends.

The fishery is largely incidental to tanner crabbing although there is some directed effort. Preliminary ADF&G statistics as of September 13, 1985 show only 30,000 pounds delivered by one vessel, and a CPUE of 10 crabs/pot-lift. Comparative statistics for 1984 were 508,000 pounds delivered by six vessels. Currently there are an estimated 4.4 (±1.7) million pounds of exploitable

stock. The fishery and markets have both been intermittent and probably will remain so during 1986. There are no guideline harvest levels, closed seasons or size limits for hair crab. There are also no estimates of the incidental catch of hair crab in trawl fisheries.

Table 1. -- Population estimates for eastern Bering Sea king crabs from NMFS surveys (millions of crab).

Bristol Bay and Pribilof Red King Crab		
Year	Pre-recruits[1]	Legals[1]
1969	20.3	9.8
1970[2]	8.4	5.3
1972	8.0	5.4
1973	25.9	10.8
1974	31.2	20.9
1975	31.7	21.0
1976	49.3	32.7
1977	63.9	37.6
1978	47.9	46.6
1979	37.2	43.9
1980	23.9	36.1
1981	18.4	11.3
1982	17.1	4.4
1983	10.4	1.5
1984	12.2	2.9
1985[3]	10.1	2.5

	Pribilof Blue King Crab		St. Matthew Blue King Crab	
Year	Pre-recruits[1]	Legals[1]	Pre-recruits[4]	Legals[4]
1974	3.1	1.9		
1975	8.0	7.5		
1976	2.1	3.9		
1977	2.2	9.4		
1978	5.8	4.3	3.3	1.8
1979	1.5	4.6	3.0	2.2
1980	1.4	4.2	3.0	2.5
1981	1.4	4.2	2.2	3.1
1982	0.7	2.2	3.3	6.8
1983	0.8	1.3	1.9	3.5
1984	0.3	0.6	0.6	1.6
1985	0.16	0.3	0.4	1.1

[1] The size groups 5.2" - 6.4" and ≥ 6.5" have been used for pre-recruits and legals, respectively.
[2] Limited survey in 1971, not used for population estimates.
[3] Preliminary estimate subject to change upon further analysis.
[4] The size groups 4.3" - 5.4" and ≥ 5.5" have been used for pre-recruits and legals, respectively.

Table 2. -- Population estimates for eastern Bering Sea tanner crabs from NMFS surveys (millions of crab).

C. bairdi

Bristol Bay and Pribilof

Year	Pre-recruits[1]	Legals[1]
1973	140.5	66.9
1974	255.0	130.5
1975	207.0	209.6
1976	136.6	109.5
1977	116.3	92.1
1978	81.2	45.6
1979	47.7	31.5
1980	65.0	31.0
1981	24.0	14.0
1982	46.9	10.1
1983	32.0	6.7
1984	21.2	5.8
1985[2]	9.4	4.4

C. opilio

	Bristol Bay and Pribilof		Northern District	
Year	Pre-recruits[3]	Large[3]	Pre-recruits[3]	Large[3]
1973	38.7	84.7		
1974	169.2	246.7		
1975	247.4	274.8		
1976	190.4	181.6		
1977	196.6	137.3		
1978	171.6	78.4	8.2	10.5
1979	146.3	106.3	20.8	6.6
1980	99.1	53.6	30.4	4.2
1981	62.7	15.7	17.1	6.5
1982	63.8	10.8	70.4	10.9
1983	91.6	12.9	50.0	9.2
1984	104.1	54.0	66.3	20.0
1985[2]	36.1	27.9	31.3	12.8

[1] A legal size limit of 5.5" carapace width was imposed in 1976, but prior to this > 5.0" was used in the "Legal" column. In parallel, pre-recruit was 3.3" - 5.0" prior to 1976 and 4.3" to 5.5" since.

[2] Preliminary estimate subject to change upon further analysis.

[3] "Large" is > 4.3" as this has been the size of most interest to U.S. industry; pre-recruit is 3.7 to 4.3". Crab in both size groups have been landed in the past two years, however, and the minimum acceptable size is fluctuating with market conditions.

Table 3. -- Population estimates for eastern Bering Sea Korean hair crab from NOAA/NMFS surveys (millions of crab).

	Pre-recruits	Large[1]
1979	4.5	16.1
1980	5.1	13.7
1981	4.8	15.9
1982	1.2	7.7
1983	0.7	4.8
1984	0.6	2.9
1985[2]	0.4	2.2

[1] "Large" is > 3.5" in width which is approximately the size at entry into the U. S. fishery; pre-cruit is 3.0" - 3.4".
[2] Preliminary estimate subject to change upon further analysis.

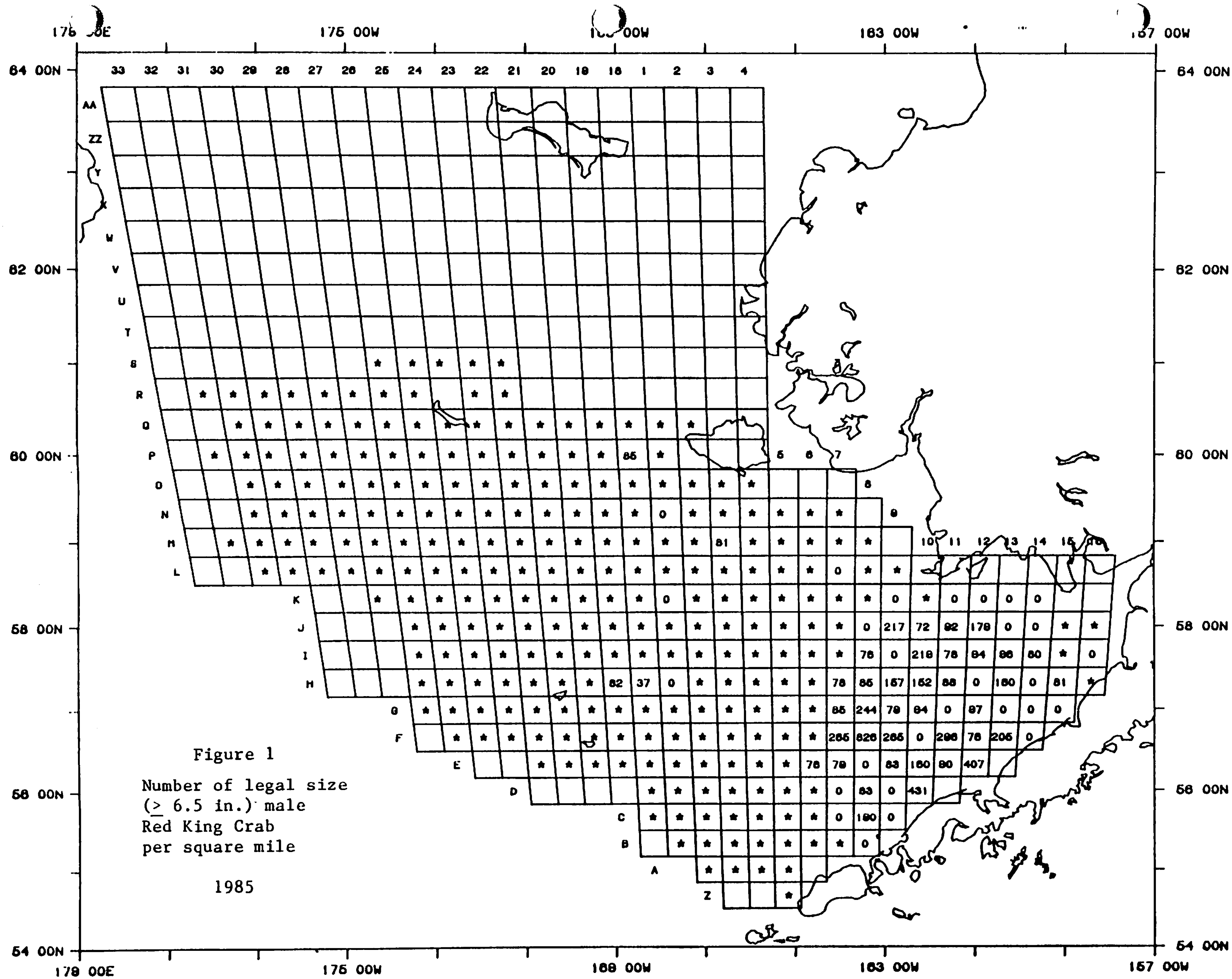

Figure 1

Number of legal size ($\geq$ 6.5 in.) male Red King Crab per square mile

1985

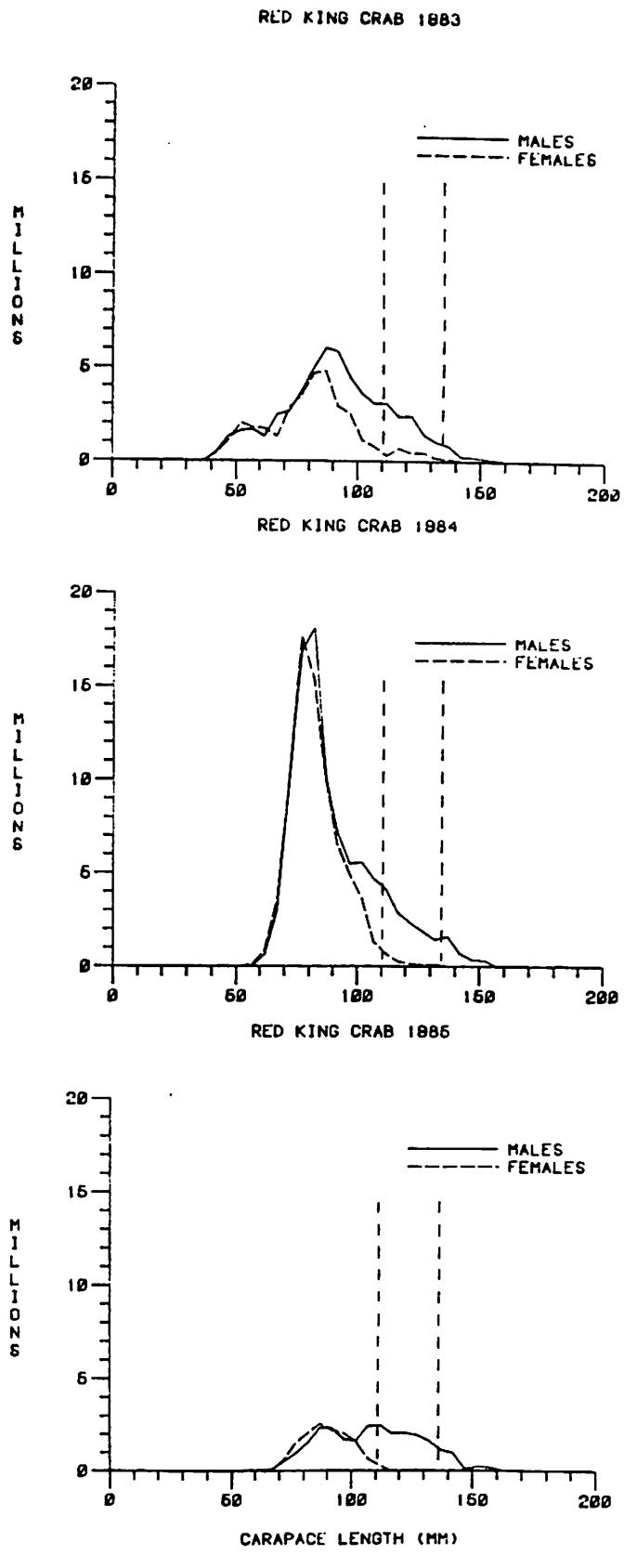

Figure 2. -- Estimates of abundance for male and female Bristol Bay District red king crab (P. camtschatica) by 5 mm length classes, 1983-1985. Dashed vertical lines indicate pre-recruit and legal sizes.

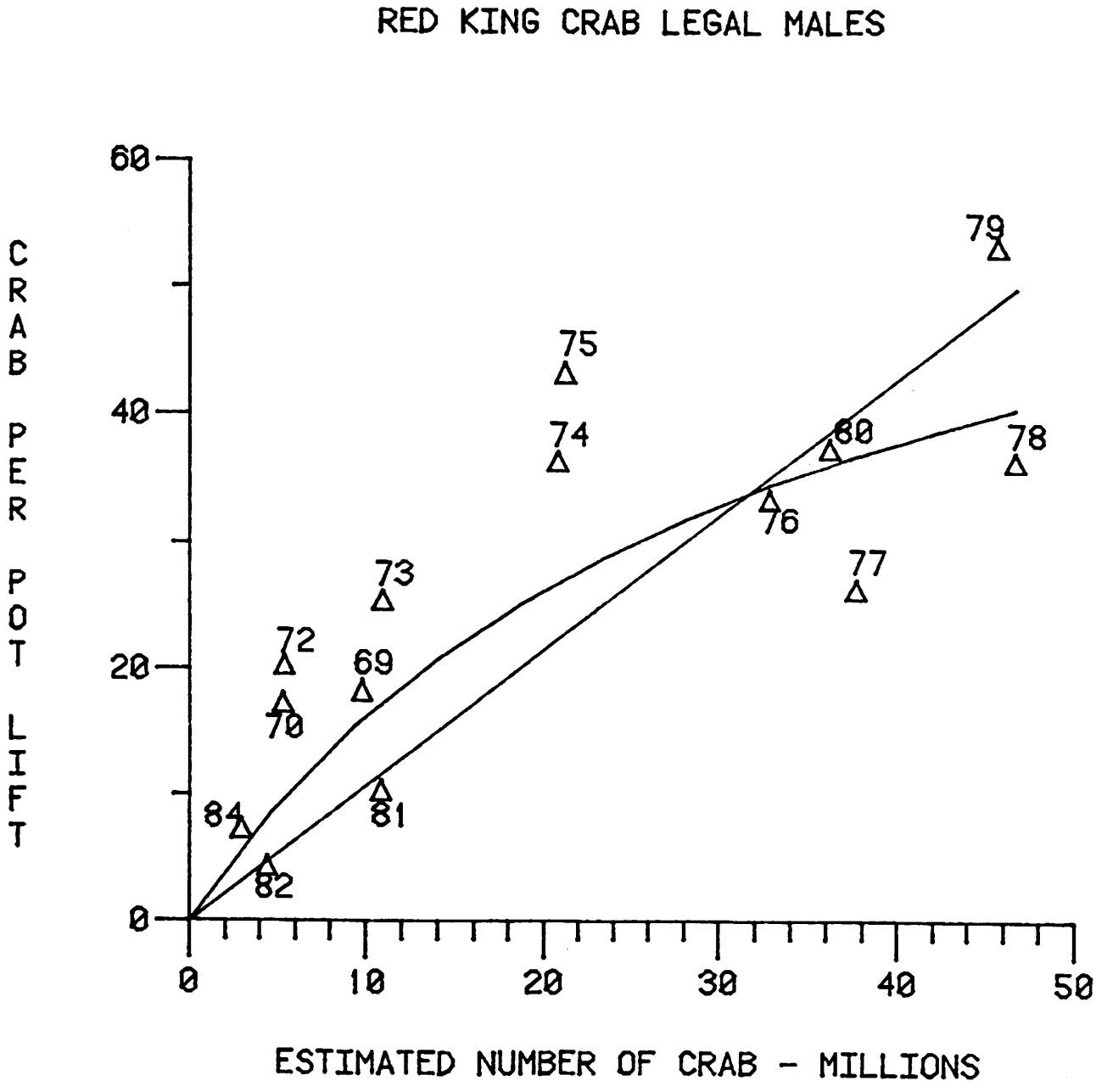

Figure 3. -- Relationship between the average number of red king crab (Paralithodes camtschatica) taken per pot in the U.S. fishery (year shown) and estimates of stock size from NMFS trawl surveys in the same year. There is no value shown for 1983 because no fishery occurred. The curved line assumes some limit to the number of crab a pot could catch.

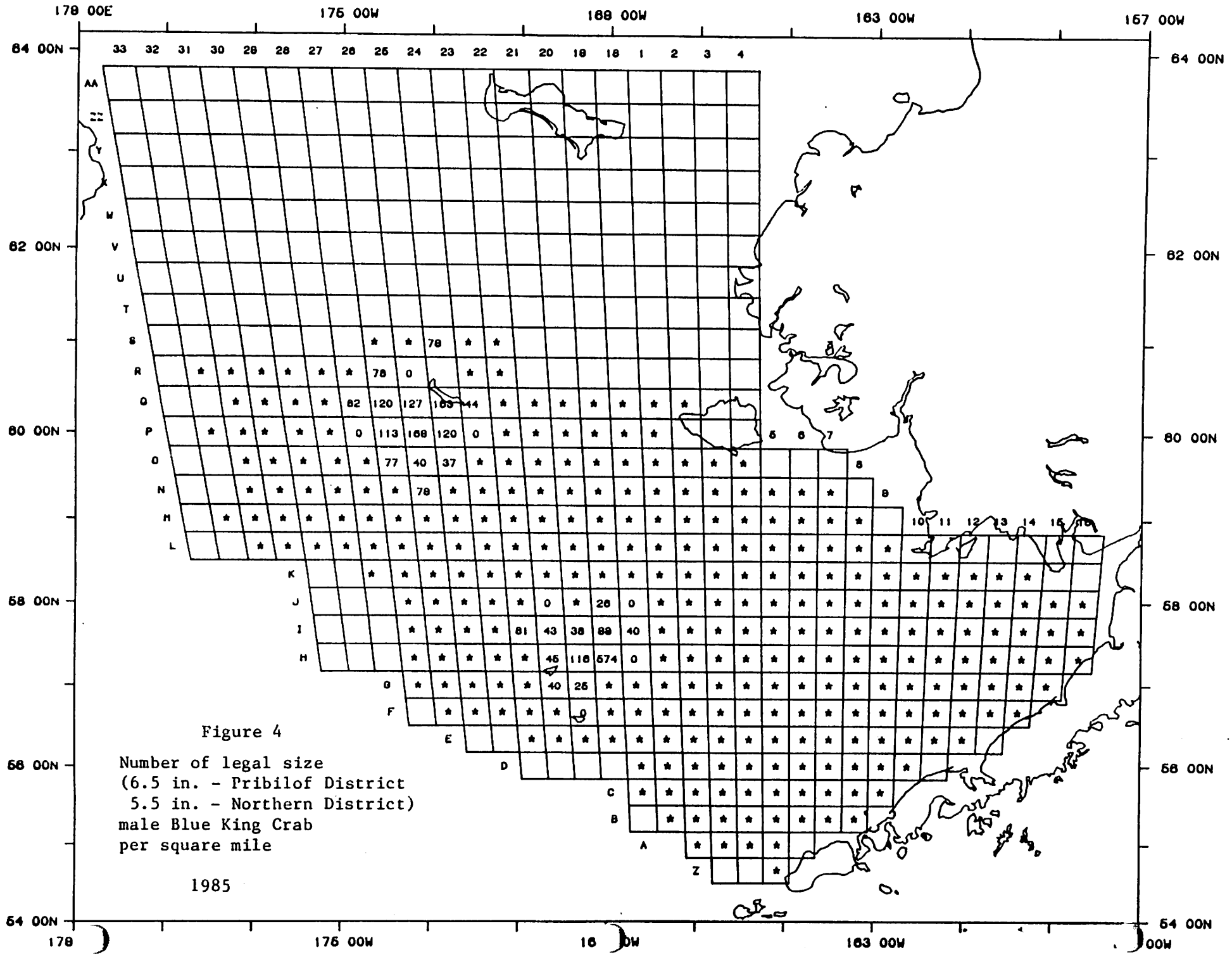

Figure 4

Number of legal size
(6.5 in. - Pribilof District
5.5 in. - Northern District)
male Blue King Crab
per square mile

1985

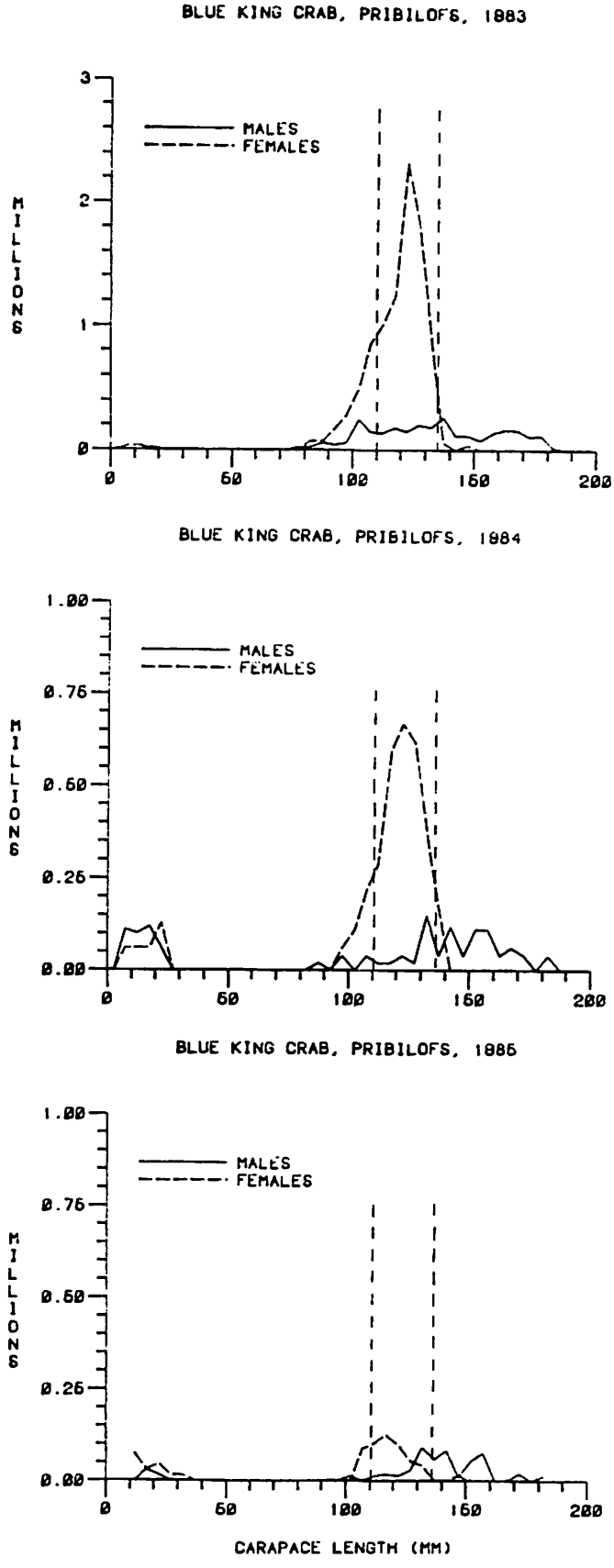

Figure 5. -- Estimates of abundance for male and female Pribilof Islands (Pribilof District) blue king crab (*P. platypus*) by 5 mm length classes, 1983-1985. Dashed vertical lines indicate pre-recruit and legal sizes.

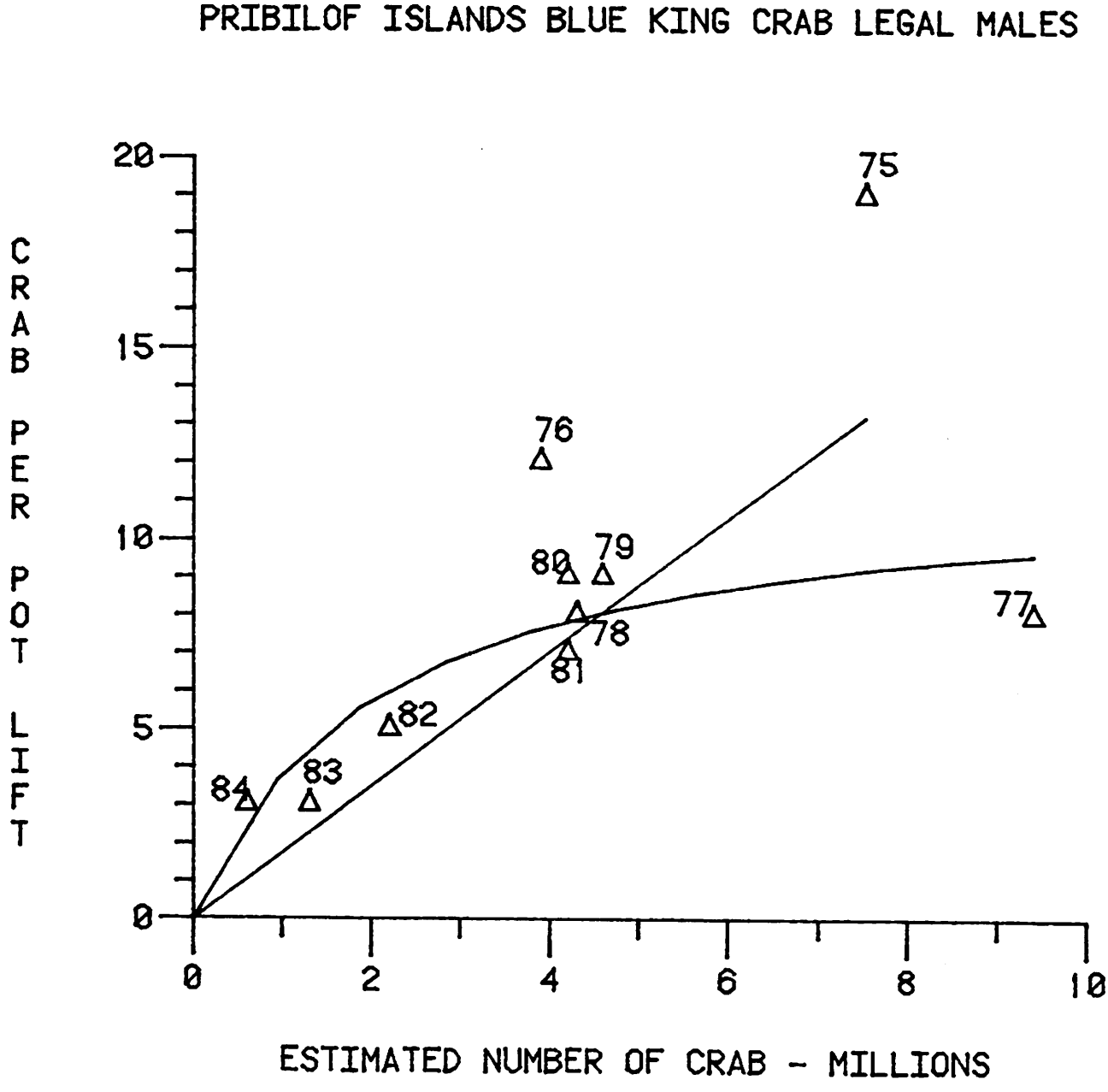

Figure 6. -- Relationship between the average number of Pribilof Island blue king crab (Paralithodes platypus) taken per pot in the U.S. fishery (year shown) and estimates of stock size from NMFS trawl surveys in the same year. The curved line assumes some limit to the number of crab a pot could catch.

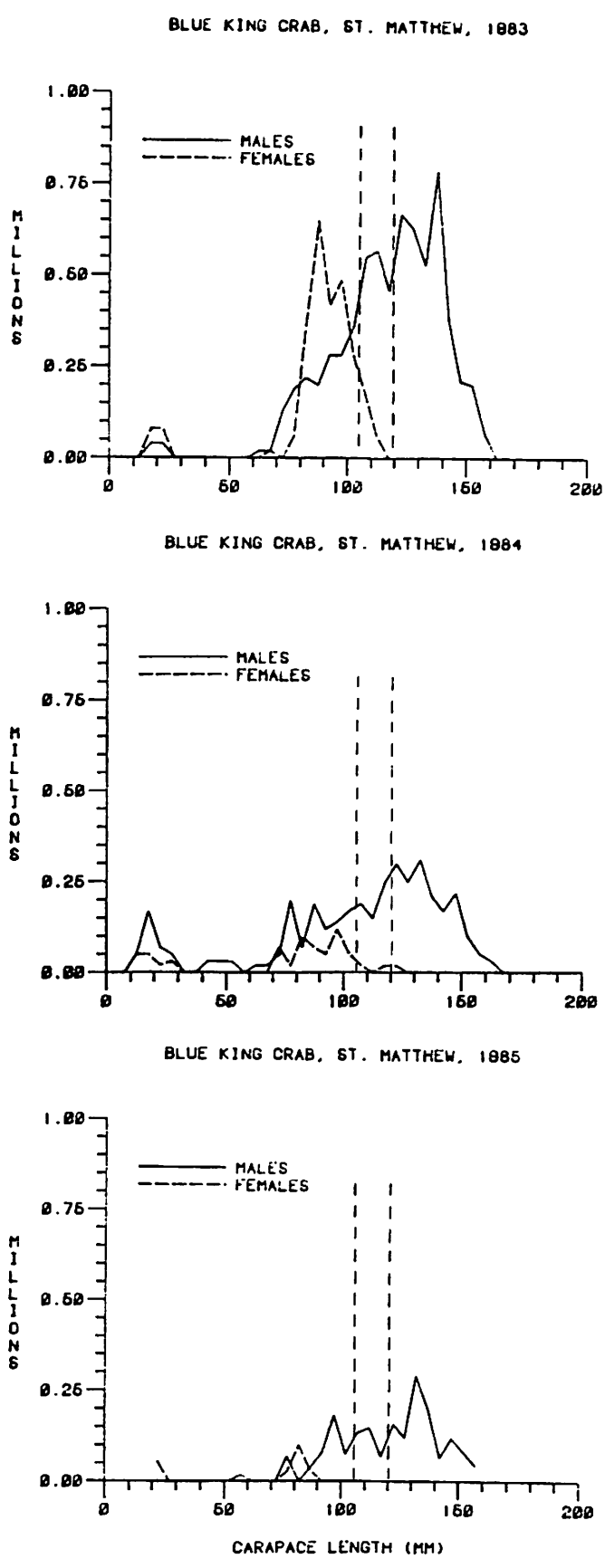

Figure 7. -- Estimates of abundance for male and female St. Matthew Island (Northern District) blue king crab (P. platypus) by 5 mm length classes, 1983-1985. Dashed vertical lines indicate pre-recruit and legal sizes.

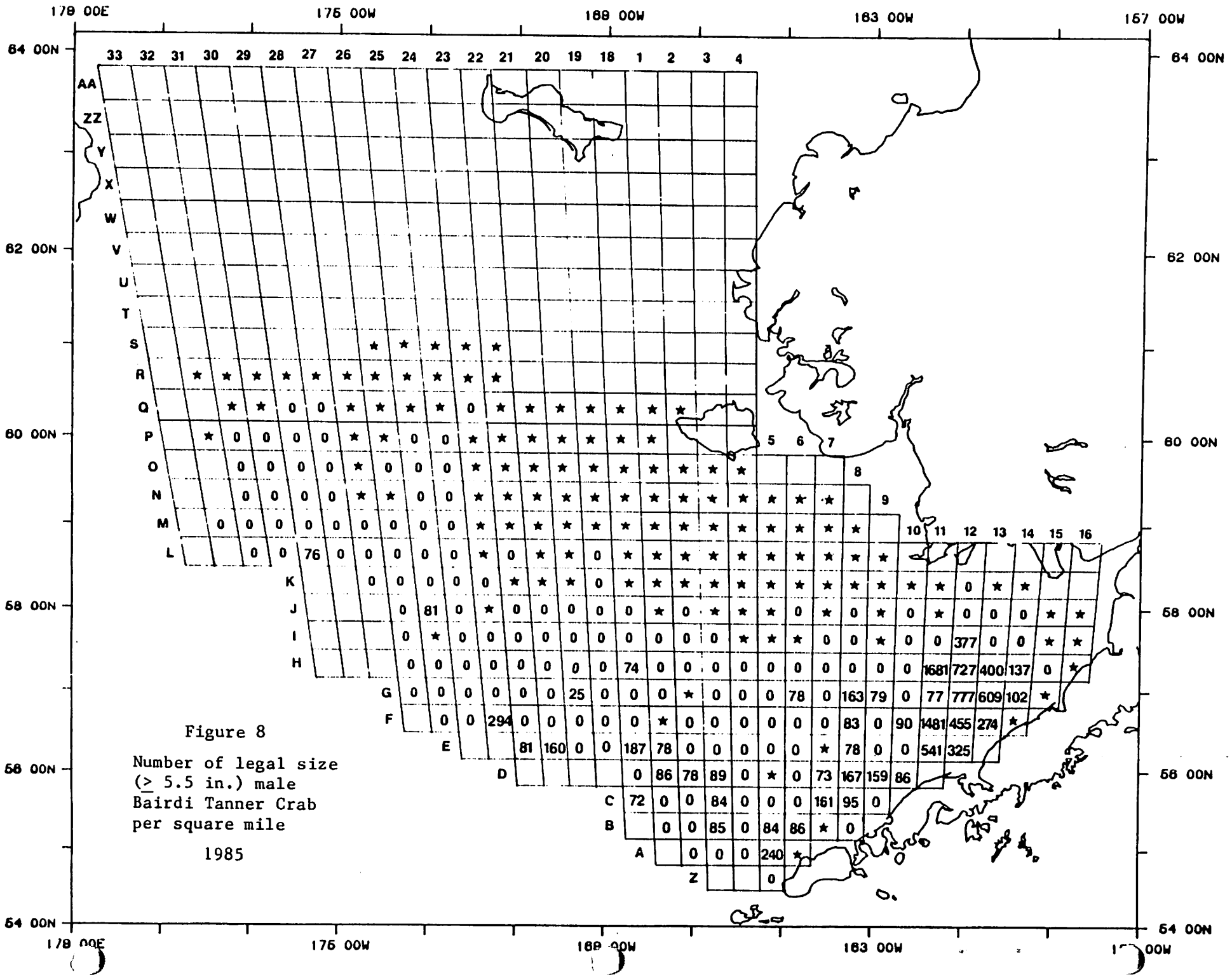

Figure 8

Number of legal size (> 5.5 in.) male Bairdi Tanner Crab per square mile

1985

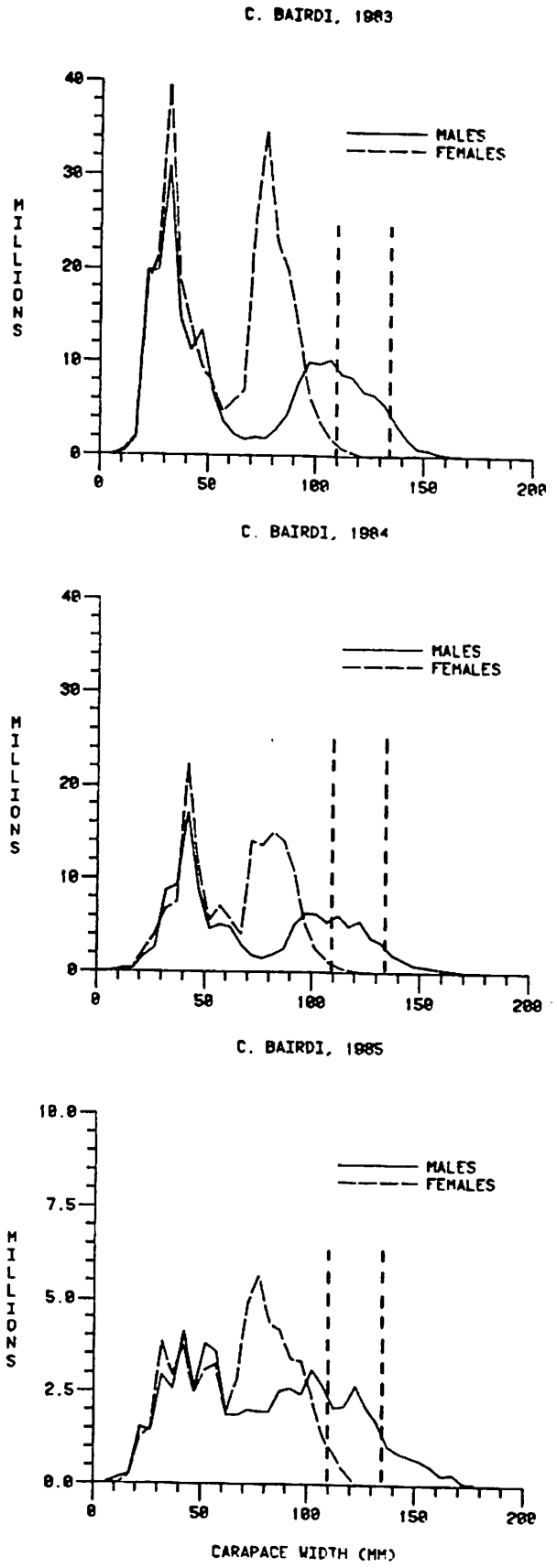

Figure 9. -- Estimates of abundance for male and female C. bairdi in the Bristol Bay and Pribilof Districts, by 5 mm width classes, 1983-1985. Dashed vertical lines indicate pre-recruit and legal sizes.

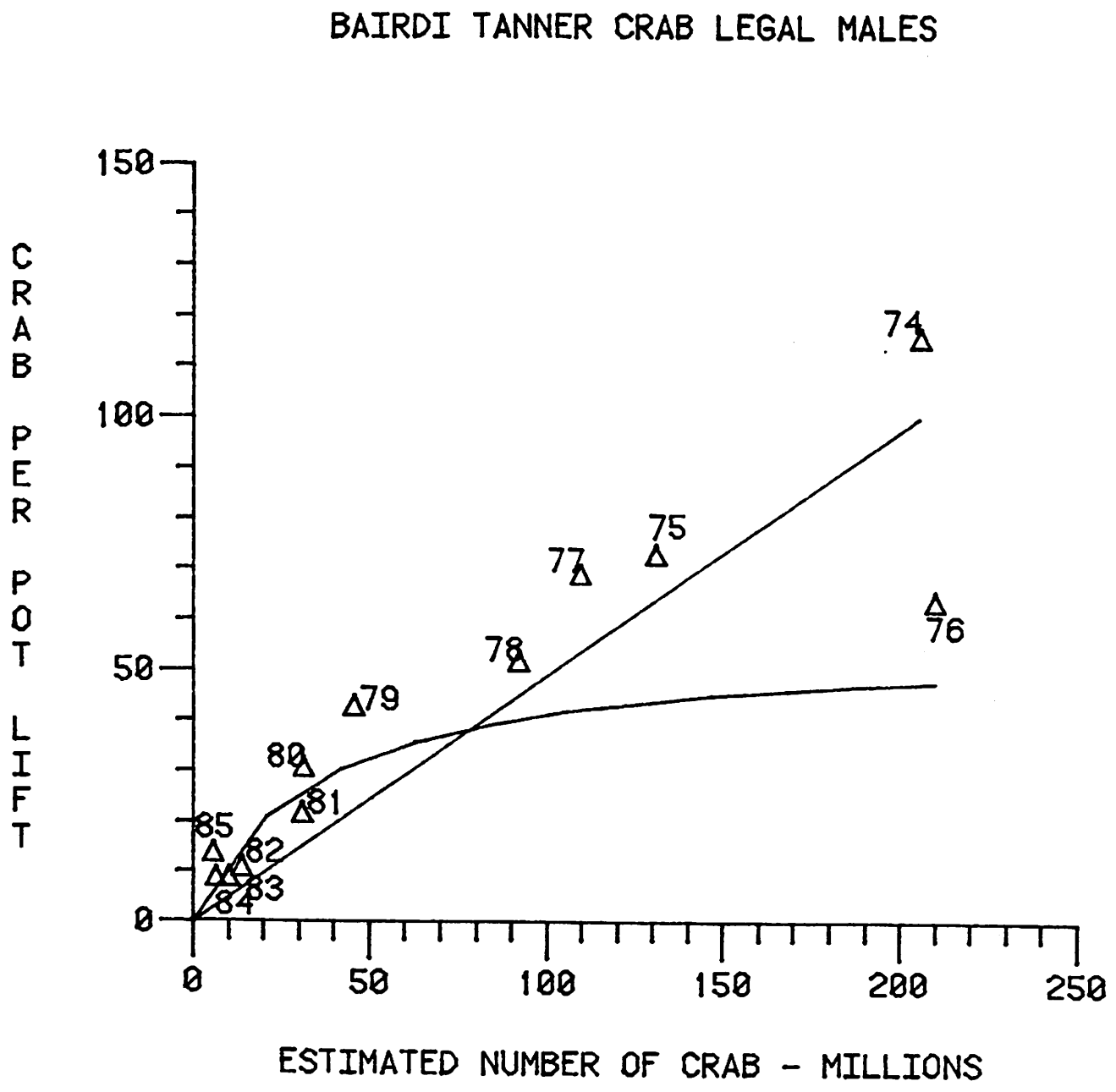

Figure 10. -- Relationship between the average number of tanner crab (Chionoecetes bairdi) taken per pot in the U.S. fishery (year shown) and estimates of stock size from NMFS trawl surveys in the preceeding year. In 1974, crab >4.7 in. included in stock size estimate: 5.5 in. size limit in effect from 1975 to present. The curved line assumes some limit to the number of crab a pot could catch.

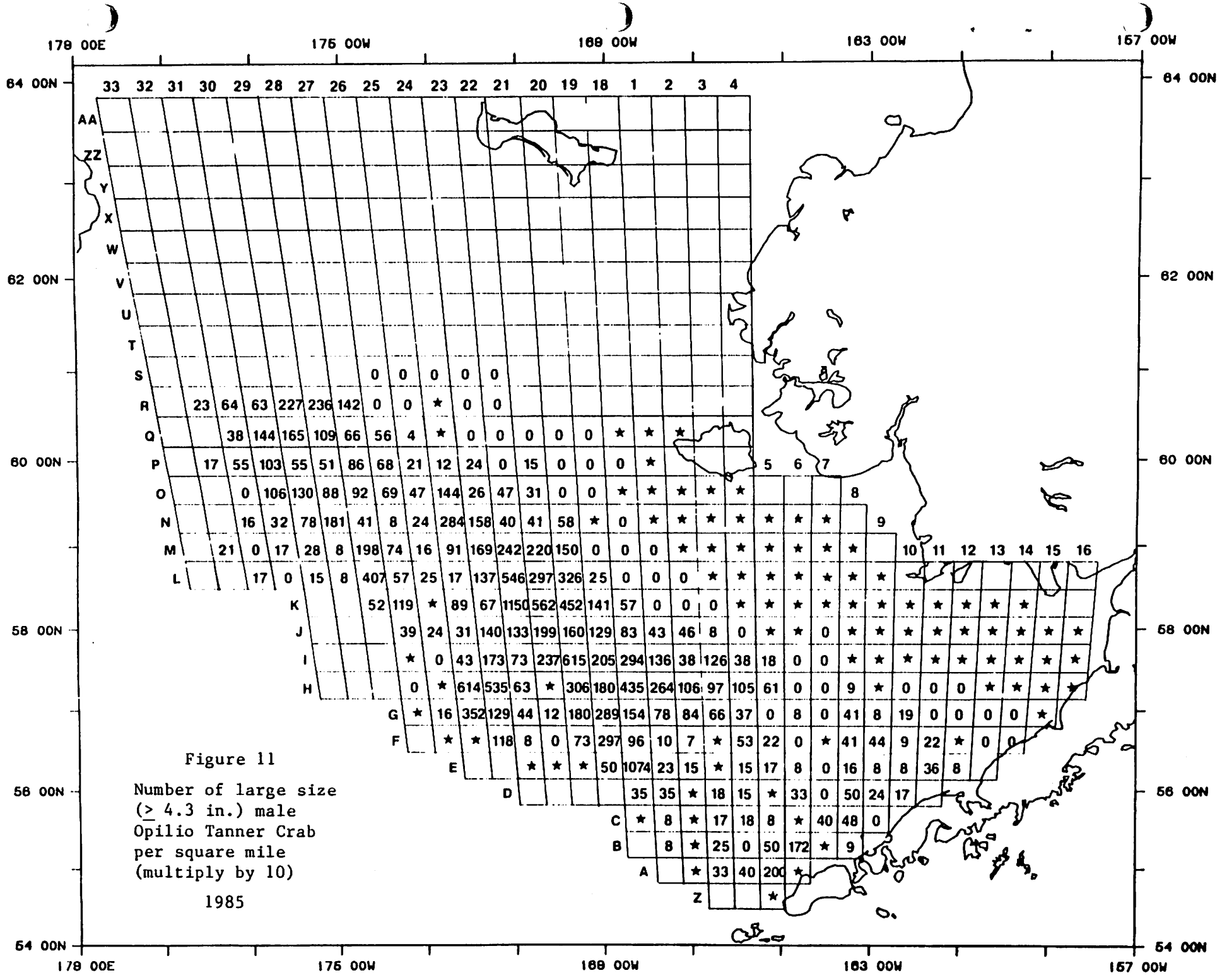

Figure 11

Number of large size (≥ 4.3 in.) male Opilio Tanner Crab per square mile (multiply by 10)

1985

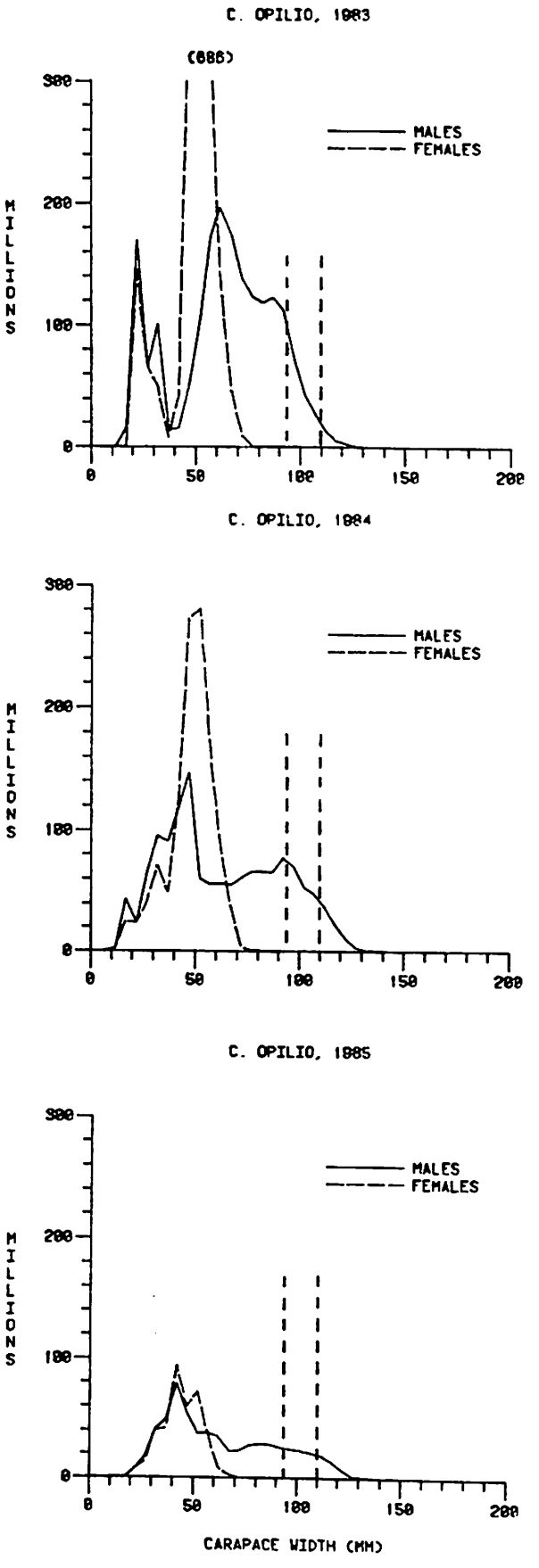

Figure 12. -- Estimates of abundance for male and female C. opilio in the combined Northern, Pribilof and Bristol Bay Districts, by 5 mm width classes, 1983-1985. Dashed vertical lines indicate pre-recruit and large sizes.

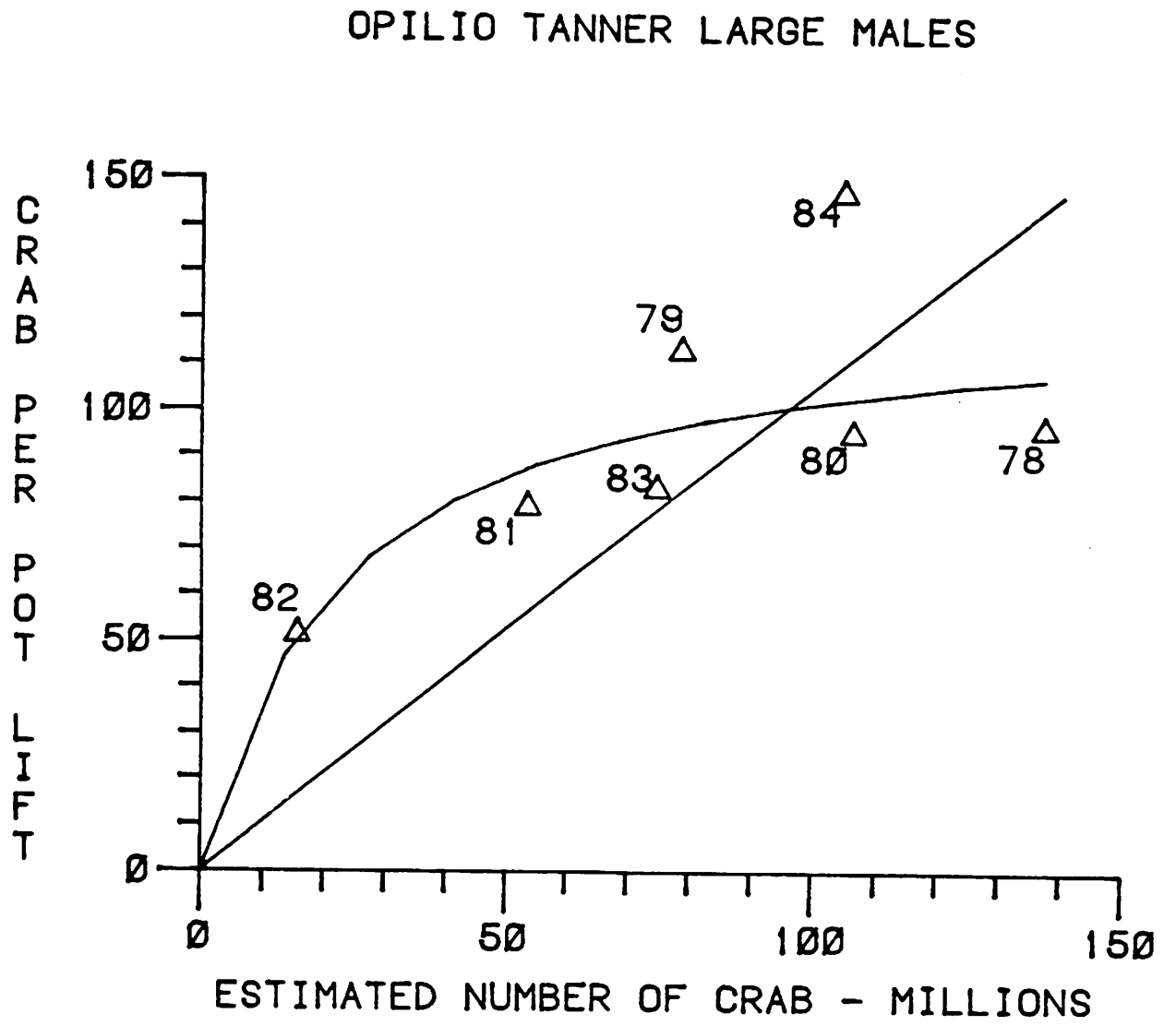

Figure 13. -- Relationship between the average number of tanner crab (Chionoecetes opilio) taken per pot in the U.S. fishery (year shown) and estimates of stock size from NMFS trawl surveys in the preceeding year. "Large" is >4.3 in from 1978-1982, >3.7 in from 1983 to present, and generally corresponds to minimum harvested size. Estimates of stock size excludes Northern District where commercial catches have been minimal. The curved line assumes some limit to the number of crab a pot could catch.

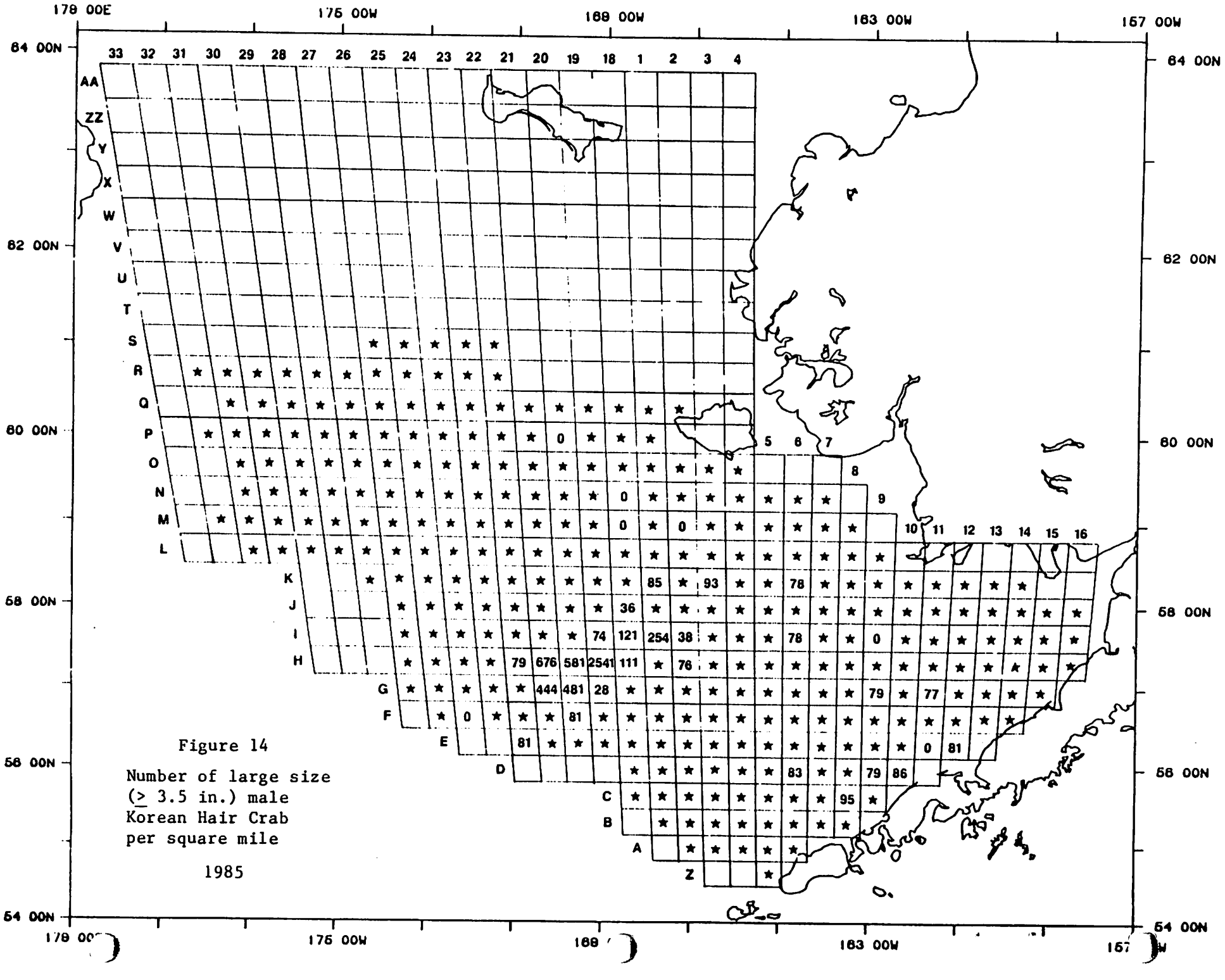

Figure 14

Number of large size (≥ 3.5 in.) male Korean Hair Crab per square mile

1985

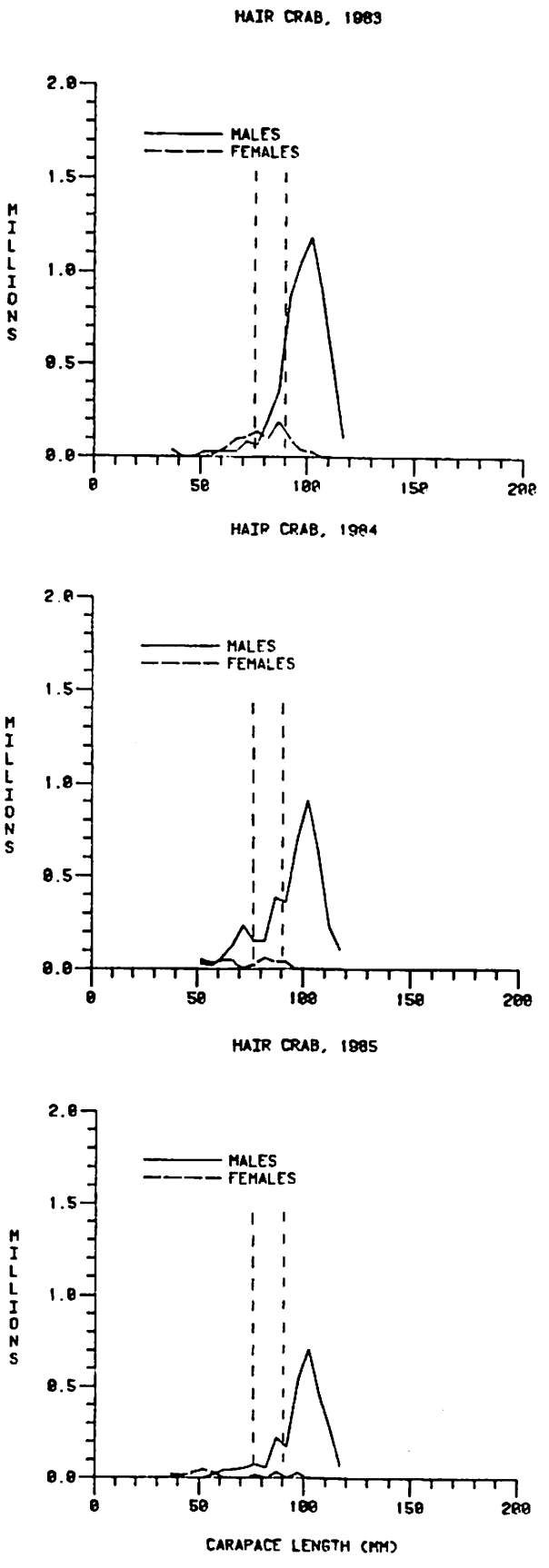

Figure 15. -- Estimates of abundance for male and female Korean hair crab (E. isenbeckii) in the combined Northern, Pribilof and Bristol Bay Districts, by 5 mm length classes, 1983-1985. Dashed vertical lines indicate pre-recruit and large sizes.