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# UNITED STATES CRAB RESEARCH IN THE EASTERN BERING SEA DURING 1987

by

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# EXECUTIVE SUMMARY

The following is a summary of conclusions presented in this report. All figures given are estimated total numbers of crabs, plus or minus 95% confidence intervals. Estimates for 1987 and 1986 were compared by t-test; values of t greater than 2.0 were defined as significant. See text for descriptions of size ranges.

Red king crab (Paralithodes camtschatica) Southeast and Pribilof Districts.
Legal males: 7.9 million ± 39%; Non-significant increase of 30%.
Pre-recruits: No significant change.
Large Females: Significant increase of 240%.
Outlook: Fishery increasing in 1987. Long-term picture of recruitment is improving.

Pribilof Islands blue king crab (P. platypus) Pribilof District.
Legal males: 732,000 ± 67%; 70% increase, not significant.
Pre-recruits: No significant change.
Large Females: Decreased, not significant.
Outlook: Fishery stable but poor. Recruitment questionable due to inadequate data.

St. Matthew blue king crab (P. platypus) Northern District.
Legal males: 737,000 ± 36%; significant increase of 90%.
Pre-recruits: No significant change.
Large Females: No significant change.
Outlook: Fishery stable but poor. Recruitment and reproduction questionable due to inadequate data.

Tanner crab (Chionoecetes bairdi) Southeast and Pribilof Districts.
Legal males: 8.3 million ± 35%; significant increase of 164%.
Pre-recruits: Significant increase of 53%.
Large Females: Significant increase of 163%.
Outlook: Fishery increasing. Significantly increased abundance of juveniles; recruitment improving.

Tanner crab (C. opilio) All districts, excluding northwest corner.
Large males: 132.6 million ± 16%; significant increase of 60%.
Small males: Significant increase of 260%.
Large Females: Significant increase of 520%.
Outlook: Population increasing. Fishery increasing due to expansion of grounds. Recruitment to fishery improving due to successful reproduction in recent years. Expect further increases in near term.

Hair crab (Erimacrus isenbeckii)
Large males: 1.2 million ± 53%; no significant change.
Pre-recruits: No significant change.
Large Females: Increased, but not significant.
Outlook: Declining fishery. Juvenile production apparently improving.

## THE SURVEY

The 1987 Eastern Bering Sea crab survey consisted of 380 successful trawl tows and covered an area of approximately 135,900 square nautical miles. The 1987 survey area was similiar to that of 1986 except that 6 stations NW of the Pribilof Islands were omitted, and 16 stations were added NW of St. Matthew Island (Fig. 1). Golden king crab were not surveyed.

The survey was conducted aboard two chartered vessels, the F/V Pat San Marie and the University of Washington's R/V Alaska between May 27 and July 30. 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. Trawl gear used was identical to that used in 1986, thus we assumed that they behaved similarly. 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. Biomass estimates are given ± 2 standard errors (approximately 95% confidence intervals).

In addition to the regular survey, 12 additional stations were towed at 10-mile intervals in water less than 25 fm deep, along the coast of the Alaska Peninsula between 160° and 162° W. long., to assess the abundance of king crab in inshore waters.

## STATUS OF STOCKS

Red King Crab (Paralithodes camtschatica) The majority of the legal (≥135 mm cl) male crabs occurred in Bristol Bay, and their distribution also extended into the Northern District (North of 58°39', Fig. 2). In Bristol Bay, the 1987 distribution extended 20 to 60 miles further west than in 1986, including the area north of Unimak Island, where legal crab have not been encountered by the survey since 1980. 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.

The high density region of legal male crabs occurred in a narrow band around 57° 20' N. lat., slightly northeast of the location of highest density observed in 1986 (Fig. 2). The single station with the highest density of legal crabs, however, was located outside of this region, just north of the Alaska Peninsula. The 12 additional inshore stations produced no appreciable numbers of king crabs; legal crabs were caught at only 3 of these stations.

The estimated abundance of legal male red king crabs in the Southeast and Pribilof Districts was 7.9 million crabs and showed a slight but non-significant[1] increase from 1986 to 1987 (Table 1). Post-recruit crab (≥ 150 mm cl), however, increased significantly by a factor of 2.4. The size frequency distribution of male crabs (Fig. 3), appears to show increased

[1]Significance was determined by the use of unpaired t-tests. Values of t greater than 2.0 were defined as significant, with probability less than 0.05.

recruitment below 100 mm cl. However, the increase was not statistically significant, so no predicitions can be made concerning future recruitment to the fishery. Overall, the male populations continued an upward trend which was first detected by the 1986 survey.

Compared to the 1986 survey, in 1987 we found more male crabs with new (soft) shells (2.8 vs 0.9%), and more with old (skipmolt) shells (12.2 vs 4.8%). Additionally many of the recently molted crabs were still fairly new shelled indicating a recent molt. This evidence suggests that a large portion of the male king crab population may have molted later than usual in 1987. However, due to the short time period covered by the survey, we do not have a clear understanding of "normal" molt timing for male crabs.

The estimated abundance of large[2] (≥90 mm cl) females in Bristol Bay increased significantly from 1986 to 1987 by a factor of 3.4, and now stands at 18.4 million crabs. The abundance of small females increased also but this increase was not significant due to high variance of the estimates. Among the mature females (i.e. those carrying external embryos or cases) 98% had molted and extruded new, uneyed eggs, and only 2% had not completed molting in contrast to 1986, when only 46% had completed extrusion by the time of the survey. Thus it appears that in 1987, as in most years, female molting, mating, and extrusion was essentially complete by mid-June.

[2]Throughout this report, the term "large females" refers to those females larger than the median size at maturity, i.e., the size at which 50% are mature. A small number of females above this size may actually be immature, but the majority are mature crabs which should contribute to reproduction of the population.

The fishery will be opened on September 25, 1987 with a guideline harvest of 13.1 million pounds (range 8.5-17.7) relative to an estimated stock of 42.7 ± 16.8 million pounds 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 16 to 20 crabs per pot-lift (Fig. 4, curved line).

Pribilof Islands Blue King Crab (P. platypus) Legal (≥135 mm cl) males were found primarily to the northeast of the islands (Fig. 5). The estimated mean abundance of legal males was 732,000 crabs, a slight but not significant increase from 1986 to 1987 (Table 2). Very few pre-recruits were caught; their estimated abundance showed no significant change from the 1986 estimate. Size-frequency data show an increase in juvenile recruitment, but it was not statistically significant (Fig. 6). Overall the population showed no significant change from 1986 levels.

The estimated abundance of large (≥90 mm cl) females showed a decrease which was not statistically significant due to large variance of the female estimates. Historically, estimates of female abundance have been imprecise due to the preference of females for rocky habitat which is not sampled well by trawls. Approximately 78% of mature females were carrying new, uneyed embryos, and the remaining 22% were in the non-egg-bearing phase (Somerton and MacIntosh 1985).

The 1986 fishery will open September 25 with a guideline harvest of 1.0 million pounds (range 0.3-1.7) as compared with an estimated 5.0 (±3.3) million pounds of legal stock. Relationships

between estimated abundance and catch rates suggest that the fleet average will be about 4 crab per pot-lift (Fig. 7). However, catch-per-unit-effort (CPUE) is usually greater than predicted for this fishery, perhaps because the trawl survey does not adequately sample rocky habitat where blue king crab commonly occur.

St. Matthew Island Blue King Crab (P. platypus) Legal (≥120 mm cl) males occur primarily south and west of the island (Fig. 5). The area over which they were distributed was similar to that of 1986. The estimated abundance of legal crabs was 737,000 crabs. This group increased significantly by a factor of 1.9 from its 1986 value (Table 3). Mean pre-recruit abundance showed no significant change. Very few large females (≥80 mm cl) were encountered by the survey, probably because they occur almost exclusively in rocky nearshore habitat. No significant changes were evident for any portion of the female population although the estimates increased slightly. Size-frequency data show a small amount of recruitment of juvenile crab, and indicate that the population is remaining stable (Fig. 8).

The 1987 fishery opened on September 1 with a guideline harvest of 0.95 million pounds (range 0.6-1.3). Preliminary Alaska Department of Fish and Game (ADF&G) statistics indicate that about 1.07 million pounds were landed by 63 vessels during a four day opening[3]. Crabs had an average weight of about 4.6 pounds. The estimated exploitation rate was 39% (by weight) or about 232,500 crabs out of an estimated legal stock of 732,000

[3]Ken Griffin, ADF&G, P.O. Box 508, Dutch Harbor, AK. 99692, pers. commun., September 1987.

crabs. In comparison, during 1986, 38 vessels landed 1.0 million pounds or 220,000 crabs for an estimated exploitation rate of 57% and an average CPUE of 10 crabs per pot-lift (ADF&G, 1987). Figure 9 shows that the survey does not predict CPUE very well for this fishery.

Tanner crab (Chionoecetes bairdi). Although the legal minimum size of 5.5 in cw is equivalent to 140 mm cw, legal crabs are defined in this report as ≥135 mm cw to reflect more accurately the size range of crabs landed.

Legal males were sparsely distributed in Bristol Bay and continental slope areas with an area of relatively high abundance in inner Bristol Bay (Fig. 10). The area of distribution was somewhat larger than that of 1986. The estimated abundance of legal male C. bairdi is 8.3 million crabs (Table 4). Over the past year the estimated abundance of legal crabs increased significantly by a factor of 2.6; the estimated abundance of pre-recruits (110 - 134 mm cw) increased significantly by a factor of 1.5; and the estimate of small males (<109 mm cw) increased significantly by a factor of 2.1. Size frequency data (Fig. 10) show what appears to be significant recruitment of juveniles over the past 2-3 years.

The abundance of large (≥85 mm cw) females also increased significantly by a factor of 2.6, and the abundance of small (<85 mm) females increased significantly by a factor of 2.9 over the 1986 estimate. Near-term recruitment to the fishery shows definite signs of improvement. Over 93% of mature females were carrying new, uneyed eggs, suggesting that the period of larval

hatching and embryo extrusion was essentially completed by the time of the survey.

Due to the low estimated abundance of C. bairdi in 1985, the Bristol Bay fishery was not opened in 1986 or 1987. Current estimates imply that the population is beginning to increase, and there are currently 17.5 ± 6.0 million lbs. available, with about 24% of that located in the Pribilofs District. Predicted catch rates would be about 8-10 crabs per pot-lift (Fig. 12). The fate of the 1987-88 fishery has not yet been decided.

Tanner Crab (C. opilio). Although the legal minimum size limit for this species is 78 mm cw, crabs smaller than 110 mm cw were not usually landed prior to 1983. However, market conditions affect the sizes at which crab are landed and processors currently prefer a minimum size of 102 mm cw (4.0 in). The size ranges for male C. opilio used in this report are defined as follows: small (<95 mm cw); intermediate (95-109 mm cl); large (≥102 mm cw); and very large (≥110 mm).

The distribution of large males showed an area of high concentration in a broad band north of the Pribilof Islands (Fig. 13). There were also areas of high abundance in the extreme northwestern portion of the survey area (Northern District) as well as in the Northwest corner (north of 60° 50' N. lat.) The distribution of intermediate size males was similar to that of large males. Prior to 1986, there was very little fishing north of 58°, and estimates of abundance (Table 5) probably included all portions of the stock which were subject to fishing even though an unknown portion of the commercially exploitable stock

may be north of the survey area. The 1987 survey showed that there are appreciable quantities of large crab north of 59° N. lat. and west of 171° W. long.

The estimated number of large (≥102 mm cw) males (all districts, excluding Northwest corner) is 132.6 million crabs, a significant increase of 1.8 times the 1986 level. Other size groups of male crabs increased also; small males by a factor of 3.6 (significant), and intermediates by a factor of 2.2 (significant). The estimated abundance of female crabs also increased significantly, by a factor of 3.5 for small females (<50 mm cw), and by a factor of 6.2 for large females (≥50 mm cw). Size frequency data (Fig. 14) indicate that recruitment to the fishery may continue to improve in the near-term. However, in the past, large populations of juveniles have been estimated which subsequently failed to recruit (e.g. 1984-1985), so any predictions must be viewed cautiously. Recruitment patterns in this stock are not entirely clear since recruitment evidently occurs both through localized production and by immigration from unsurveyed areas. Approximately 16% of all male crabs ≥100 mm cw, i.e. the exploited stock, were found to be softshell, in contrast to 1986, when 46% were. Apparently the molting period is quite variable from year to year. As noted previously, the term "large females" generally includes most of the mature crabs and some immatures. In C. opilio, the median size at maturity varies with latitude, from approximately 50.0 mm cw at 60° N. lat., increasing in a southerly direction, to about 60.0 mm at 57° N. lat. In other words, at the southern edge of the range of females, a greater proportion of the large females (≥ 50 mm cw)

are immature. We now think that this is a result of differences in growth and/or molting rates from north to south and may be a regular feature of the population. Of those crabs that were actually mature, about 98% carried new uneyed embryos indicating that the embryo hatching and extrusion season was completed by the time of the survey.

The 1987 fishery was closed on June 22. Preliminary 1987 ADF&G statistics were not available as of the writing of this report. Currently there is an estimated 186.1 (± 28.2) million pounds of large males (≥102 mm cw) within the survey area of which about 8.4% exists in the Northwest corner, an area which was not surveyed prior to 1987. Relationships between catch rates and population estimates (for males ≥95 mm, 157 million crabs) indicate the catch rates in 1987 could be around 130 crabs per pot (Fig. 15). No guideline harvests for 1987 have been determined.

Recent fishery landings have appeared excessive compared to the estimated biomass. This inconsistency was partially due to increased fishing pressure in the Northern District, much of which lay outside the region covered by the NMFS trawl surveys prior to 1987. Thus, our estimates did not include the entire stock that was being exploited in 1985-1986. In addition, there is reason to believe that the catchability of C. opilio (and perhaps C. bairdi as well) in the survey is less than 1.0, i.e. that they are routinely underestimated by trawls, perhaps much more so than king crabs. At present, the fishery appears to have expanded about as far as possible geographically; landings in 1987 did not increase as much as they did in 1986. Despite the

high landings and expanding grounds, these factors do not appear to have caused adverse impacts to the Bering Sea stock of C. opilio.

One of the difficulties in estimating and reporting population estimates for C. opilio (as well as C. bairdi) is that the boundaries of the management districts have no biological significance, i.e., they do not correspond to any natural biological boundaries of the crab populations. In fact, the lower boundary of the Northern District, at 58°, cuts exactly through the center of the highest density region of large male C. opilio. Thus, minor shifts in the location of the high density region, perhaps due to temperature changes in the Bering Sea, could erroneously be perceived as changes in population abundance. For example, abundance south of 58° N. lat. is currently only about 50% of historically high levels, whereas abundance in the Northern District is 2.5 times greater than the highest previous estimate.

From a biological as well as statistical perspective, it would be more sensible to draw a boundary which separates the two high density regions which have been a constant feature of this stock for many years. Such a boundary could be drawn from Cape Mohican, Nunivak Island, to the continental shelf edge at 58° N., 174° W. An alternative would be to divide the population into eastern and western stocks with a dividing line at approximately 172° W. long. Either choice would enable more precise estimation of populations and reporting, and better management of the fishery for this species.

Hair Crab (Erimacrus isenbeckii) 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. 16). The abundance of hair crabs has been declining since 1981 (Table 6); the 1987 estimate of 1.2 million large (≥90 mm cl) males shows no significant change (all districts combined) over the past year. However, the estimated abundance of total females represents a significant increase over 1985 levels, though not from 1986 levels. Size-frequency data (Fig. 17) show improved recruitment of very small crabs of both sexes.

Landings are largely incidental to tanner crabbing although there is occasionally some directed effort. Preliminary ADF&G statistics for 1987 were not available as of this writing. Currently there are an estimated 2.4 (±1.3) million pounds of large male crabs. The fishery and markets have both been intermittent and probably will remain so during 1987. There are no guideline harvest levels, closed seasons or size limits for hair crab. CPUE has not been predictable due to low effort.

## LITERATURE CITED

Alaska Dept. Fish and Game, 1987. Westward Region shellfish report to the Alaska Board of Fisheries. ADF&G, Div. of Commercial Fisheries, Westward Regional Office, 211 Mission Rd, Kodiak, AK., 99615, 317 p.

Somerton, D., and R.A. MacIntosh, 1986. Reproductive biology of the female blue king crab Paralithodes platypus near the Pribilof Islands, Alaska, J. Crustacean. Biol. 5:365-376.

Table 1. -- Annual abundance estimates (millions of crabs) for red king crab (*P. camtschatica*) in the Pribilof and Bristol Bay Districts from NMFS surveys.

| | Males | | | | Females | | | Grand |
|---|---|---|---|---|---|---|---|---|
| Size[1](mm) Width(in) | <110 <5.2 | 110-134 5.2-6.5 | ≥135 ≥6.5 | Total | <90 <3.5 | ≥90 ≥3.5 | Total | Total |
| 1969 | 41.0 | 20.3 | 9.8 | 71.1 | 18.3 | 28.5 | 46.8 | 117.9 |
| 1970 | 9.5 | 8.4 | 5.3 | 23.2 | 4.9 | 13.0 | 17.9 | 41.1 |
| 1972[2] | 14.1 | 8.0 | 5.4 | 27.5 | 7.0 | 12.1 | 19.1 | 46.6 |
| 1973 | 50.0 | 25.9 | 10.8 | 86.7 | 24.8 | 76.8 | 101.6 | 188.3 |
| 1974 | 59.0 | 31.2 | 20.9 | 111.1 | 37.7 | 72.0 | 109.7 | 220.8 |
| 1975 | 84.9 | 31.7 | 21.0 | 137.6 | 70.8 | 58.9 | 129.7 | 267.3 |
| 1976 | 70.2 | 49.3 | 32.7 | 152.2 | 35.9 | 71.8 | 107.7 | 259.9 |
| 1977 | 80.2 | 63.9 | 37.6 | 181.7 | 33.5 | 150.1 | 183.6 | 365.3 |
| 1978 | 62.9 | 47.9 | 46.6 | 157.4 | 38.2 | 128.4 | 166.6 | 324.0 |
| 1979 | 48.1 | 37.2 | 43.9 | 129.2 | 45.1 | 110.9 | 156.0 | 285.2 |
| 1980 | 56.8 | 23.9 | 36.1 | 116.8 | 44.8 | 67.6 | 112.5 | 229.3 |
| 1981 | 56.6 | 18.4 | 11.3 | 86.3 | 36.3 | 67.3 | 103.6 | 189.9 |
| 1982 | 107.2 | 17.4 | 4.7 | 129.3 | 77.2 | 54.8 | 132.0 | 261.3 |
| 1983[3] | 43.3 | 10.4 | 1.5 | 55.2 | 24.3 | 9.7 | 34.0 | 89.2 |
| 1984 | 81.8 | 12.6 | 3.1 | 97.6 | 57.6 | 17.6 | 75.1 | 172.7 |
| 1985 | 13.7 | 10.1 | 2.5 | 26.3 | 6.9 | 6.8 | 13.7 | 39.9 |
| 1986 | 11.8 | 12.3 | 5.9 | 30.1 | 4.5 | 5.4 | 9.8 | 39.9 |
| 1987 | 20.1 | 12.6 | 7.9 | 40.6 | 16.8 | 18.3 | 35.1 | 75.7 |
| Limits[4] | | | | | | | | |
| Lower | 8.0 | 7.4 | 4.8 | 23.9 | 0.0 | 7.7 | 11.6 | 35.5 |
| Upper | 32.2 | 17.8 | 11.0 | 57.2 | 33.6 | 28.9 | 58.6 | 115.8 |
| ±% | 60 | 41 | 39 | 41 | 100 | 58 | 67 | 53 |

[1] Carapace length (mm).
[2] Limited survey in 1971, not used for population estimate.
[3] 1983 and 1984 data include small numbers of crab from the Northern District.
[4] Mean ± 2 standard errors for 1987.

Table 2. -- Annual abundance estimates (millions of crabs) for blue king c
(P. platypus) in the Pribilof District from NMFS surveys.

Pribilof District

| Size[1](mm) Width(in) | Males <110 <5.2 | 110-134 5.2-6.5 | ≥135 ≥6.5 | Total | Females <90 <3.5 | ≥90 ≥3.5 | Total | Grand Total |
|---|---|---|---|---|---|---|---|---|
| 1974 | 4.4 | 3.1 | 1.9 | 9.4 | 0.6 | 10.9 | 11.5 | 20.9 |
| 1975 | 4.1 | 8.0 | 7.5 | 19.6 | 0.0 | 8.8 | 8.8 | 28.4 |
| 1976 | 10.3 | 2.1 | 3.9 | 16.3 | 0.4 | 17.7 | 18.1 | 34.4 |
| 1977 | 3.2 | 2.2 | 9.4 | 14.8 | 2.2 | 17.5 | 19.7 | 34.5 |
| 1978 | 1.2 | 5.8 | 4.3 | 11.3 | 0.3 | 35.5 | 35.8 | 47.1 |
| 1979 | 6.4 | 1.5 | 4.6 | 12.5 | 5.2 | 2.9 | 8.1 | 20.6 |
| 1980 | 1.9 | 1.4 | 4.2 | 7.5 | 0.8 | 101.9 | 102.7[3] | 110.2 |
| 1981 | 4.8 | 1.4 | 4.2 | 10.4 | 3.4 | 11.6 | 15.0 | 25.4 |
| 1982 | 1.2 | 0.7 | 2.2 | 4.1 | 0.7 | 8.6 | 9.3 | 13.4 |
| 1983 | 0.6 | 0.8 | 1.3 | 2.8 | 0.2 | 9.2 | 9.4 | 12.2 |
| 1984 | 0.5 | 0.3 | 0.6 | 1.3 | 0.3 | 3.1 | 3.4 | 4.8 |
| 1985 | 0.06 | 0.16 | 0.32 | 0.54 | 0.18 | 0.52 | 0.70 | 1.24 |
| 1986 | 0.02 | 0.02 | 0.43 | 0.47 | 0.04 | 1.86 | 1.90 | 2.37 |
| 1987 | 0.57 | 0.08 | 0.73 | 1.38 | 0.39 | 0.58 | 0.97 | 2.35 |
| Limits[2] | | | | | | | | |
| Lower | 0.0 | 0.0 | 0.24 | 0.22 | 0.0 | 0.0 | 0.05 | 0.27 |
| Upper | 1.56 | 0.18 | 1.22 | 2.54 | 0.98 | 1.26 | 1.87 | 4.41 |
| ±% | 173 | 129 | 67 | 84 | 151 | 118 | 95 | 88 |

1 Carapace length (mm).
2 Mean ± 2 standard errors for 1987.
3 Female estimates considered unreliable in 1980.

Table 3. -- Annual abundance estimates (millions of crabs) for blue king crab (*P. platypus*) in the Northern District from NMFS surveys.

Northern District

| Grand Size[1](mm) Width(in) | Males <105 <4.3 | Males 105-119 4.3-5.5 | Males ≥120 ≥5.5 | Males Total | Females <80 <3.2 | Females ≥80 ≥3.2 | Females Total | Total |
|---|---|---|---|---|---|---|---|---|
| 1978 | 5.6 | 2.4 | 1.8 | 9.8 | 0.8 | 0.4 | 1.2 | 11.0 |
| 1979 | 4.9 | 2.3 | 2.2 | 9.4 | 1.7 | 0.9 | 2.6 | 12.0 |
| 1980 | 3.4 | 2.2 | 2.5 | 8.1 | 0.8 | 2.2 | 3.0 | 11.1 |
| 1981 | 1.2 | 1.8 | 3.1 | 6.3 | 0.0 | 0.5 | 0.5 | 6.8 |
| 1982 | 3.2 | 2.6 | 6.8 | 12.5 | 0.4 | 0.7 | 1.1 | 13.7 |
| 1983 | 1.8 | 1.6 | 3.5 | 6.9 | 0.2 | 2.4 | 2.7 | 9.6 |
| 1984 | 1.4 | 0.6 | 1.6 | 3.6 | 0.2 | 0.5 | 0.7 | 4.3 |
| 1985 | 0.46 | 0.35 | 1.08 | 1.89 | 0.08 | 0.13 | 0.21 | 2.10 |
| 1986 | 0.56 | 0.40 | 0.38 | 1.34 | 0.25 | 0.06 | 0.31 | 1.65 |
| 1987 | 1.07 | 0.73 | 0.74 | 2.53 | 0.46 | 0.22 | 0.68 | 3.21 |
| Limits[2] | | | | | | | | |
| Lower | 0.44 | 0.34 | 0.47 | 1.39 | 0.07 | 0.08 | 0.21 | 1.60 |
| Upper | 1.70 | 1.12 | 1.01 | 3.67 | 0.85 | 0.36 | 1.15 | 4.82 |
| ±% | 59 | 54 | 36 | 45 | 84 | 62 | 69 | 50 |

[1] Carapace length (mm), categories reflect smaller average size in the Northern District; 80 mm is the median size at maturity for females.
[2] Mean ± 2 standard errors for 1987.

Table 4 -- Annual abundance estimates (millions of crabs) for Tanner crabs (C. bairdi) in the Pribilof and Bristol Bay Districts from NMFS surveys.

| | Males | | | | Females | | | Grand Total |
|---|---|---|---|---|---|---|---|---|
| Size(mm) Width(in) | <110 <4.3 | 110-134 4.3-5.3 | >134 ≥5.3 | Total | <90 <3.4 | ≥90 ≥3.4 | Total | |
| 1976 | 180.2 | 136.6 | 109.5 | 426.3 | 174.7 | 220.4 | 395.1 | 821.4 |
| 1977 | 255.0 | 116.3 | 92.1 | 463.4 | 328.4 | 215.8 | 544.2 | 1,007.6 |
| 1978 | 124.2 | 81.2 | 45.6 | 251.0 | 116.1 | 73.3 | 189.4 | 440.4 |
| 1979 | 133.1 | 47.7 | 31.5 | 212.3 | 122.6 | 42.1 | 164.7 | 377.0 |
| 1980 | 453.3 | 65.0 | 31.0 | 549.3 | 326.9 | 106.8 | 433.7 | 983.0 |
| 1981 | 303.8 | 24.0 | 14.0 | 341.8 | 324.2 | 79.1 | 403.3 | 745.1 |
| 1982 | 88.8 | 46.9 | 10.1 | 145.8 | 126.4 | 83.6 | 210.0 | 355.8 |
| 1983 | 146.3 | 32.0 | 6.7 | 185.0 | 180.1 | 45.4 | 225.5 | 410.5 |
| 1984 | 85.1 | 21.2 | 5.8 | 112.1 | 107.0 | 33.4 | 140.4 | 252.5 |
| 1985 | 31.1 | 9.4 | 4.4 | 44.9 | 24.2 | 15.6 | 39.8 | 84.7 |
| 1986 | 110.4 | 12.9 | 3.1 | 126.4 | 68.2 | 13.7 | 81.9 | 208.3 |
| 1987 | 230.1 | 19.7 | 8.3 | 258.0 | 193.3 | 35.5 | 228.8 | 486.8 |
| Limits[2] | | | | | | | | |
| Lower | 151.9 | 15.2 | 5.4 | 179.2 | 108.8 | 18.4 | 135.1 | 314.3 |
| Upper | 308.3 | 24.2 | 11.1 | 336.8 | 277.9 | 52.5 | 322.5 | 659.3 |
| ± % | 34 | 23 | 35 | 31 | 44 | 48 | 41 | 35 |

Table 5. -- Annual abundance estimates for eastern Bering Sea Tanner crabs (C. opilio) from NMFS surveys (millions of crab).

Table 5A. Pribilof and Bristol Bay Districts

| | Males | | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|---|
| Size[1](mm) Width(in) | <95 <3.7 | 95-109 3.7-4.3 | ≥102 ≥4.0 | ≥110 ≥4.3 | Total | <50 <2.0 | ≥50 ≥2.0 | Total | Grand Total |
| 1976 | * | 190.4 | * | 181.6 | 2402.7 | * | * | 5564.4 | 7967.1 |
| 1977 | * | 196.6 | * | 137.3 | 1988.2 | * | * | 6390.5 | 8378.7 |
| 1978 | * | 171.6 | * | 78.4 | 908.6 | * | * | 1344.5 | 2253.1 |
| 1979 | * | 146.3 | * | 105.9 | 875.8 | * | * | 2389.1 | 3264.9 |
| 1980 | * | 99.1 | * | 53.6 | 624.0 | * | * | 2959.6 | 3583.7 |
| 1981 | * | 62.7 | * | 15.7 | 1002.7 | * | * | 2091.8 | 3094.5 |
| 1982 | 695.5 | 63.8 | * | 10.8 | 770.1 | 181.5 | 1343.8 | 1525.3 | 2295.5 |
| 1983 | 470.0 | 92.1 | * | 12.9 | 574.9 | 118.2 | 606.5 | 724.8 | 1299.7 |
| 1984 | 182.6 | 104.1 | 106.5 | 54.0 | 340.6 | 41.5 | 290.0 | 331.5 | 672.2 |
| 1985 | 151.4 | 36.1 | 48.2 | 27.9 | 215.4 | 88.0 | 8.6 | 96.6 | 312.0 |
| 1986 | 450.7 | 37.4 | 52.2 | 30.7 | 518.8 | 541.1 | 160.2 | 701.3 | 1220.1 |
| 1987 | 984.5 | 53.1 | 57.0 | 28.8 | 1066.5 | 658.0 | 1207.8 | 1865.8 | 2932.3 |
| Limits[2] | | | | | | | | | |
| Lower | 529.3 | 37.7 | 41.9 | 21.1 | 606.5 | 147.0 | 573.6 | 928.8 | 1535.3 |
| Upper | 1439.7 | 68.6 | 72.1 | 36.6 | 1526.5 | 1169.0 | 1842.1 | 2802.8 | 4329.3 |
| ± | 46 | 29 | 26 | 27 | 43 | 78 | 53 | 50 | 48 |

[1] Carapace width in mm.
[2] Mean ± 2 standard errors.

* Data not available at present time.

Table 5. (cont.) -- Annual abundance estimates for eastern Bering Sea Tanner crabs (C. opilio) from NMFS surveys (millions of crab).

Table 5B. Northern District (Excluding Northwest "corner")

| | Males | | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|---|
| Size[1](mm) Width(in) | <95 <3.7 | 95-109 3.7-4.3 | ≥102 ≥4.0 | ≥110 ≥4.3 | Total | <50 <2.0 | ≥50 ≥2.0 | Total | Grand Total |
| 1978 | * | 8.2 | * | 10.5 | * | * | * | * | * |
| 1979 | * | 20.8 | * | 6.6 | * | * | * | * | * |
| 1980 | * | 30.4 | * | 4.2 | * | * | * | * | * |
| 1981 | * | 17.1 | * | 6.5 | * | * | * | * | * |
| 1982 | 1221.8 | 70.4 | * | 10.9 | 1303.1 | 221.1 | 912.0 | 1133.1 | 2436.2 |
| 1983 | 1224.1 | 49.8 | * | 9.2 | 1283.2 | 554.9 | 621.9 | 1187.8 | 2460.0 |
| 1984 | 963.7 | 66.3 | 46.7 | 20.0 | 1050.0 | 569.0 | 291.7 | 860.7 | 1910.7 |
| 1985 | 363.1 | 31.3 | 26.7 | 12.8 | 407.2 | 170.2 | 114.9 | 285.1 | 692.3 |
| 1986 | 693.8 | 34.2 | 30.9 | 15.2 | 743.2 | 249.5 | 261.7 | 511.2 | 1254.4 |
| 1987 | 3132.9 | 104.1 | 75.6 | 31.3 | 3268.3 | 2077.0 | 1410.0 | 3487.0 | 6755.3 |
| Limits[2] | | | | | | | | | |
| Lower | 1569.1 | 80.0 | 61.5 | 24.6 | 1703.9 | 832.8 | 942.7 | 2042.0 | 3745.9 |
| Upper | 4696.8 | 128.1 | 89.7 | 37.9 | 4832.6 | 3321.3 | 1877.3 | 4932.0 | 9764.6 |
| ±% | 50 | 23 | 19 | 21 | 48 | 60 | 33 | 41 | 45 |

[1] Carapace width in mm.
[2] Mean ± 2 standard errors.

* Data not available at present time.

Table 5 (cont.) -- Annual abundance estimates for eastern Bering Sea Tanner crabs (C. opilio) from NMFS surveys (millions of crab).

Table 5C. Northwest "corner" [1]

| | Males | | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|---|
| Size[2](mm) Width(in) | <95 <3.7 | 95-109 3.7-4.3 | ≥102 ≥4.0 | ≥110 ≥4.3 | Total | <50 <2.0 | ≥50 ≥2.0 | Total | Grand Total |
| 1987 | 266.1 | 12.8 | 11.7 | 6.3 | 285.3 | 168.3 | 177.4 | 345.7 | 631.0 |
| Limits[3] | | | | | | | | | |
| Upper | 132.6 | 5.3 | 4.8 | 2.4 | 154.4 | 60.2 | 59.3 | 140.2 | 294.6 |
| Lower | 400.0 | 20.4 | 18.7 | 10.2 | 416.2 | 276.4 | 295.5 | 551.2 | 967.4 |
| ±% | 50 | 59 | 59 | 61 | 46 | 64 | 67 | 59 | 53 |

[1] Triangular region bounded by U. S. - Soviet Convention Line on west, 60°50' W. lat. on south, and 174°30' W. long. on east.
[2] Carapace width in mm.
[3] Mean ± 2 standard errors.

Table 6 -- Annual abundance estimates (millions of crabs) for hair crabs (Erimacrus isenbeckii) from NMFS surveys. The size at entry to the U. S. fishery is approximately 90 mm (3.5 in) carapace length.

| | Males | | | Females | |
|---|---|---|---|---|---|
| Size[1] (mm) Length(in) | <90 <3.5 | ≥90 ≥3.5 | Total | Total | Grand Total |
| 1979 | 6.4 | 16.1 | 22.5 | 1.6 | 24.1 |
| 1980 | 6.0 | 13.7 | 19.7 | 3.1 | 22.8 |
| 1981 | 6.1 | 15.9 | 22.0 | 0.8 | 22.8 |
| 1982 | 1.4 | 7.7 | 9.1 | 0.4 | 9.5 |
| 1983 | 0.9 | 4.8 | 5.7 | 0.9 | 6.6 |
| 1984 | 1.1 | 2.9 | 4.0 | 0.4 | 4.4 |
| 1985 | 0.53 | 2.22 | 2.75 | 0.22 | 2.97 |
| 1986 | 0.71 | 1.46 | 2.17 | 0.37 | 2.54 |
| 1987 | 1.95 | 1.19 | 3.14 | 0.91 | 4.05 |
| Limits[2] | | | | | |
| Lower | 0.62 | 0.56 | 1.65 | 0.40 | 2.05 |
| Upper | 3.28 | 1.82 | 4.63 | 1.41 | 6.04 |
| ±% | 68 | 53 | 47 | 56 | 49 |

[1] Carapace length (mm).
[2] Mean ± 2 standard errors for 1987.

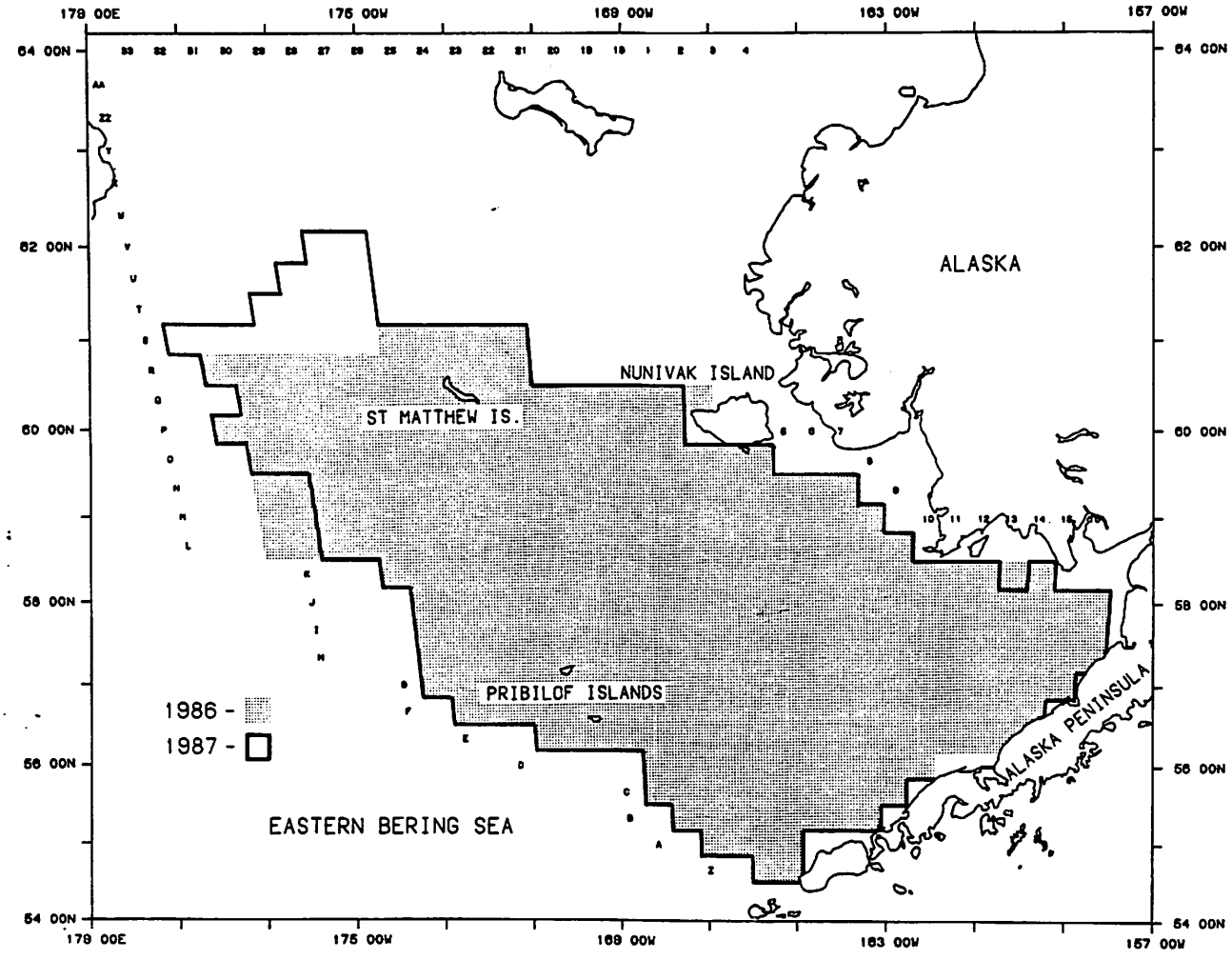
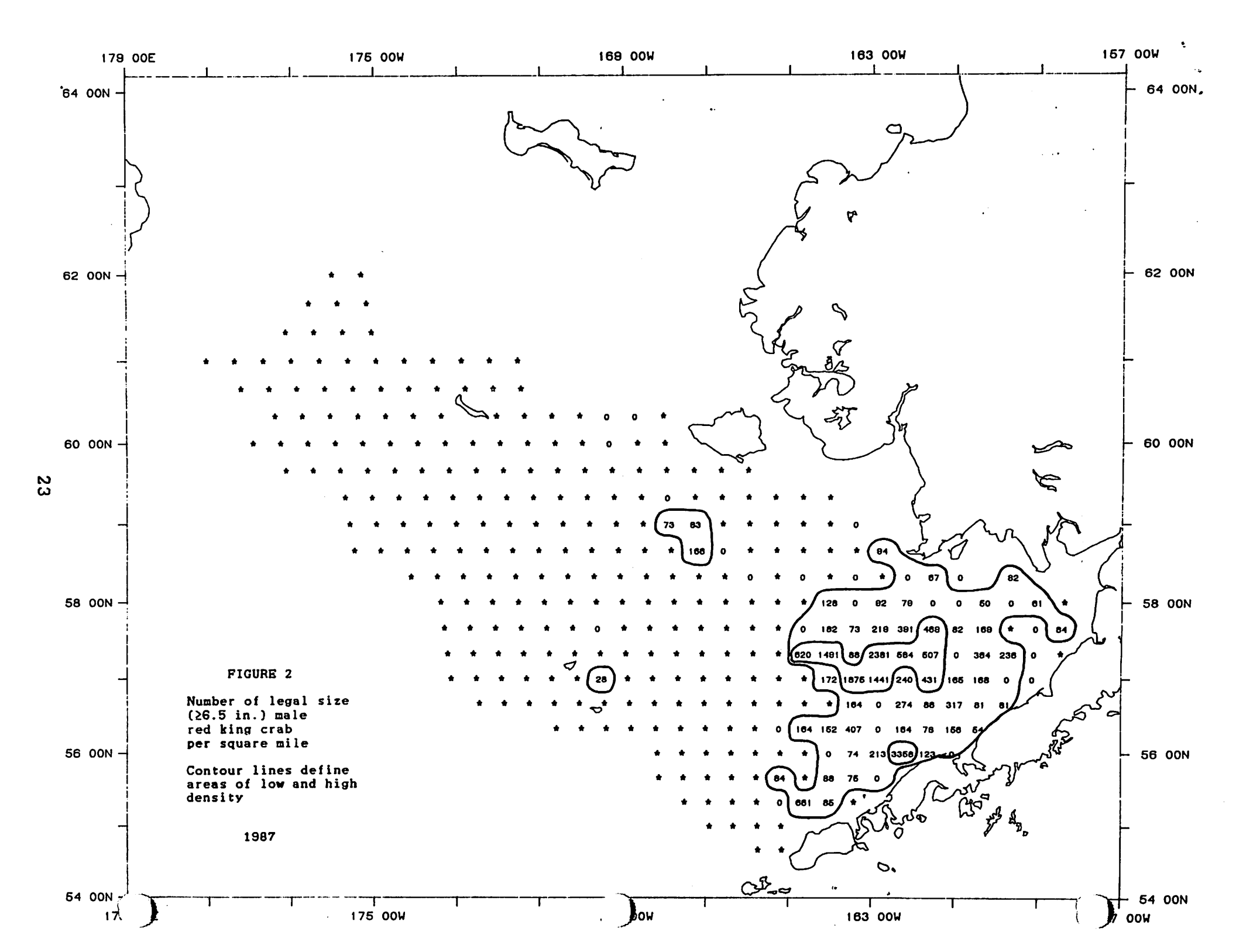



Figure 1. -- NMFS eastern Bering Sea crab survey area in 1986 and 1987.


179 00E
175 00W
168 00W
163 00W
157 00W
64 00N
62 00N
60 00N
58 00N
56 00N
54 00N
175 00W
163 00W
FIGURE 2
Number of legal size (≥6.5 in.) male red king crab per square mile
Contour lines define areas of low and high density
1987

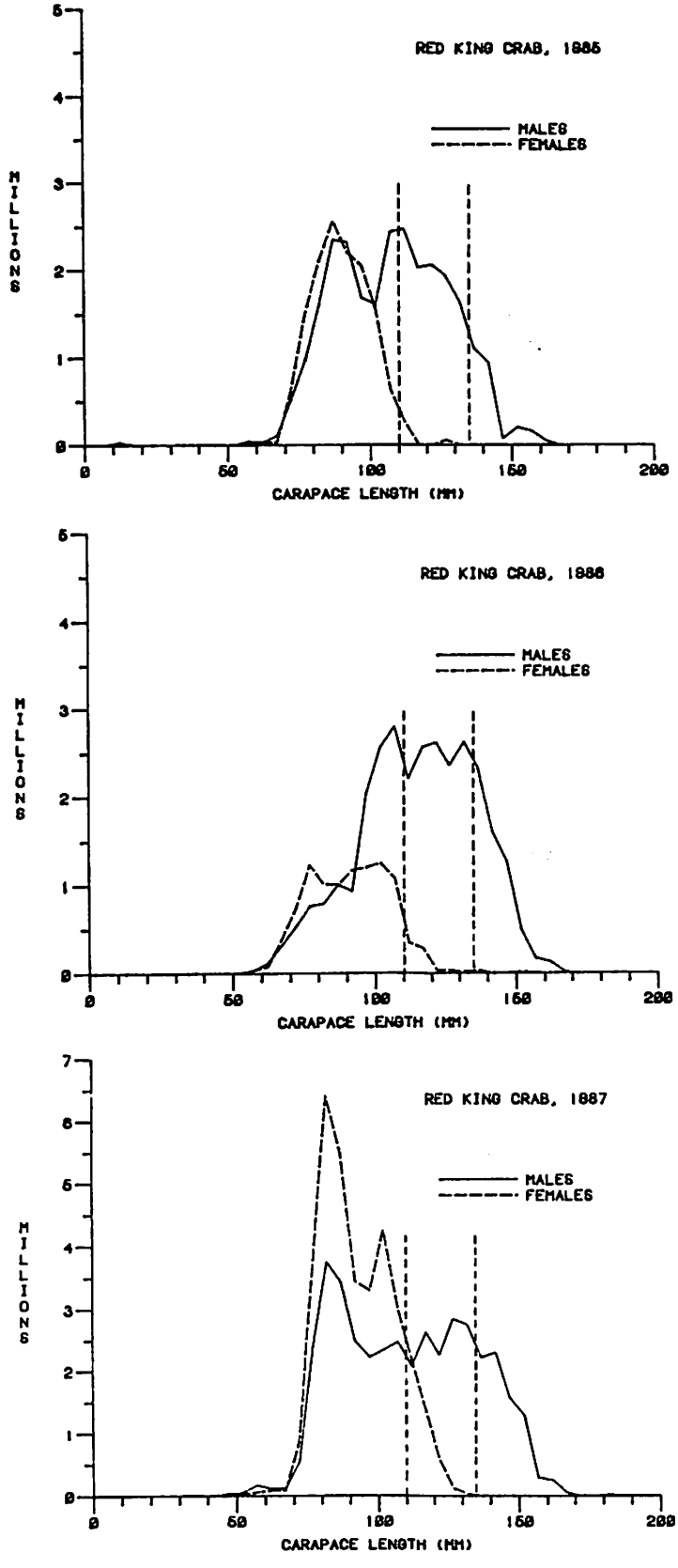



Figure 3. -- Estimates of abundance for male and female Bristol Bay District red king crab (P. camtschatica) by 5 mm length classes, 1985-1987. Dashed vertical lines indicate pre-recruit and legal sizes. Note difference in vertical scale for 1987.

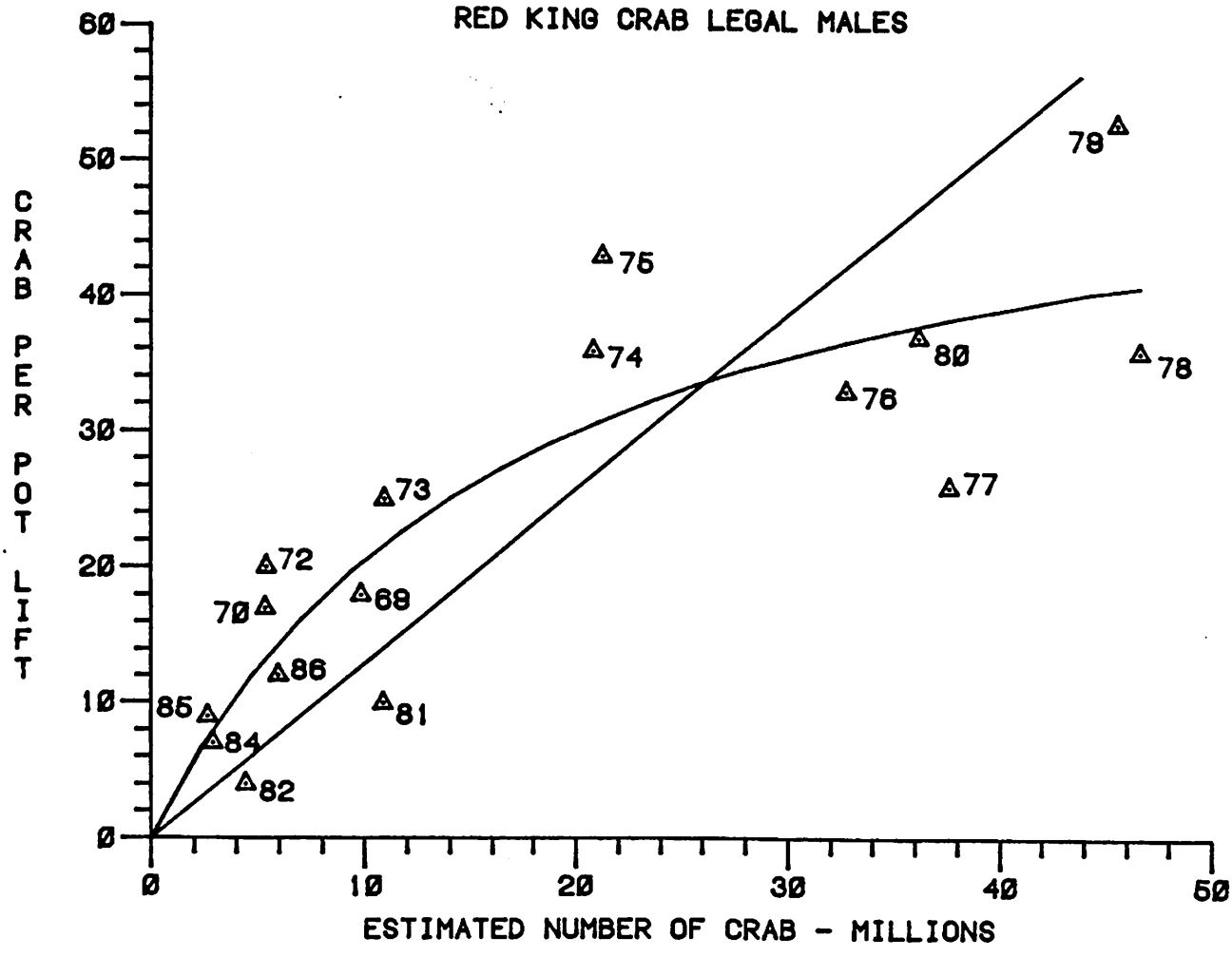



Figure 4. -- Relationship between the average number of red king crab (Paralithodes camtschatica) taken per pot in the U.S. fishery (year shown) and estimates of legal stock size from NMFS trawl surveys in the same year. No fishery occurred in 1983. The curved line assumes some limit to the number of crab a pot could catch.

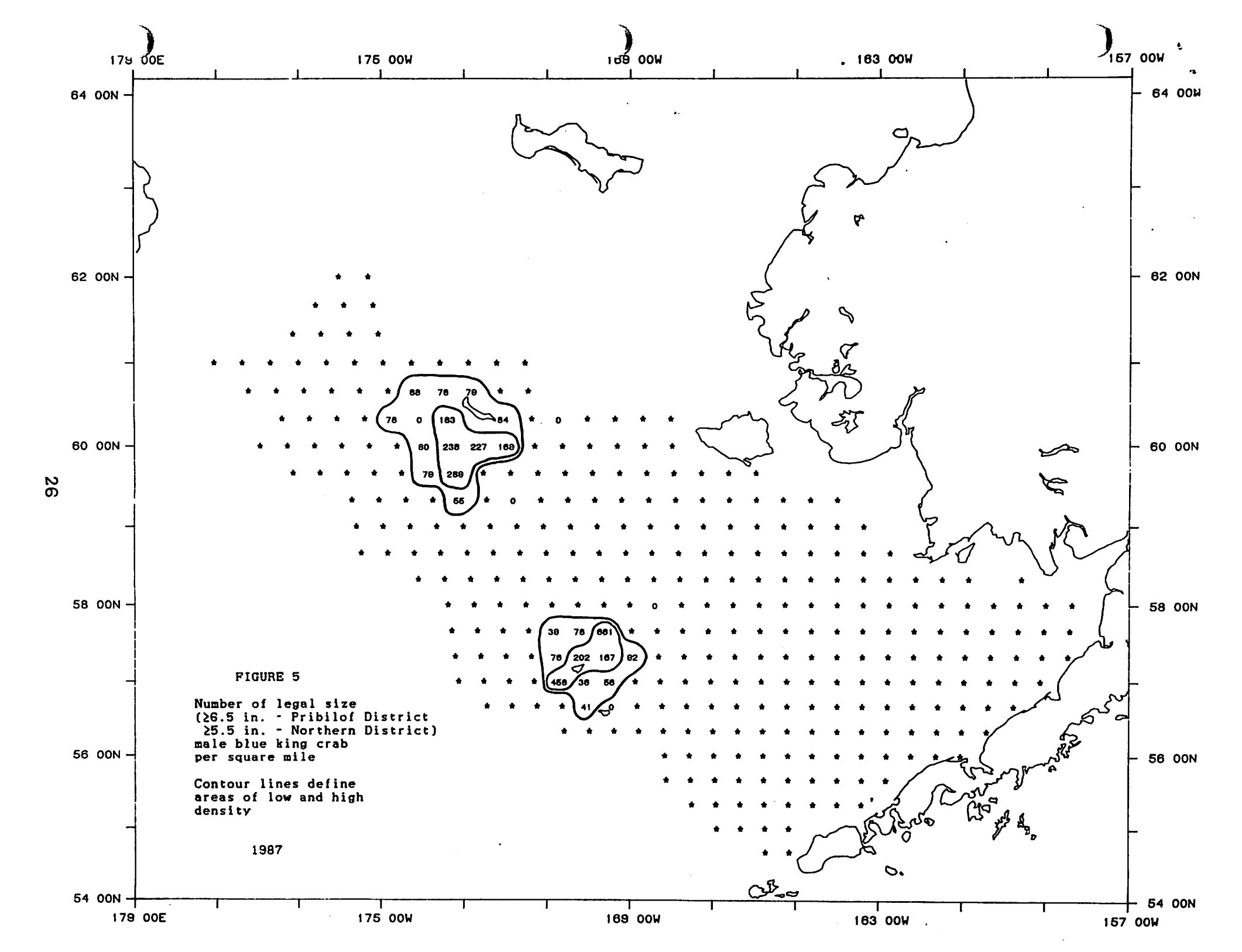



FIGURE 5

Number of legal size
(≥6.5 in. - Pribilof District
≥5.5 in. - Northern District)
male blue king crab
per square mile

Contour lines define
areas of low and high
density

1987

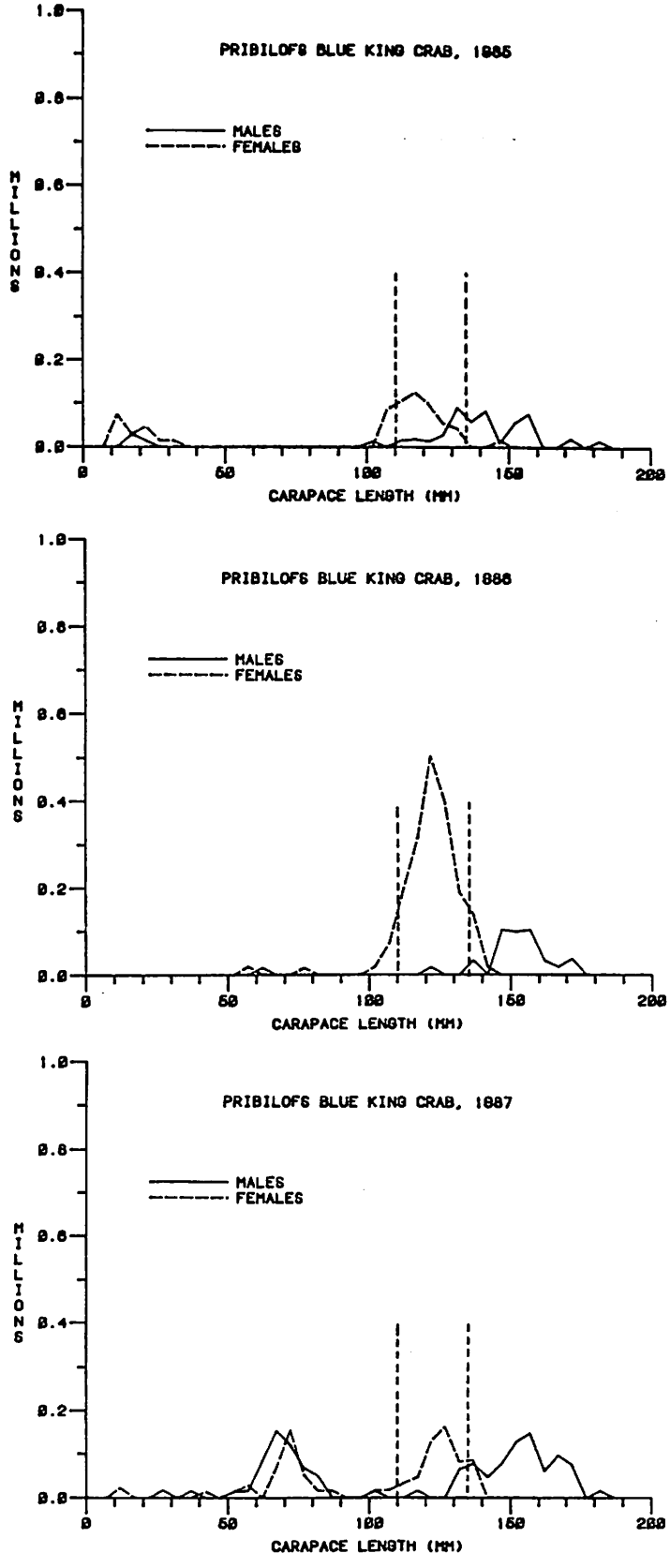



Figure 6. -- Estimates of abundance for male and female Pribilof Islands (Pribilof District) blue king crab (P. platypus) by 5 mm length classes, 1985-1987. Dashed vertical lines indicate pre-recruit and legal sizes.

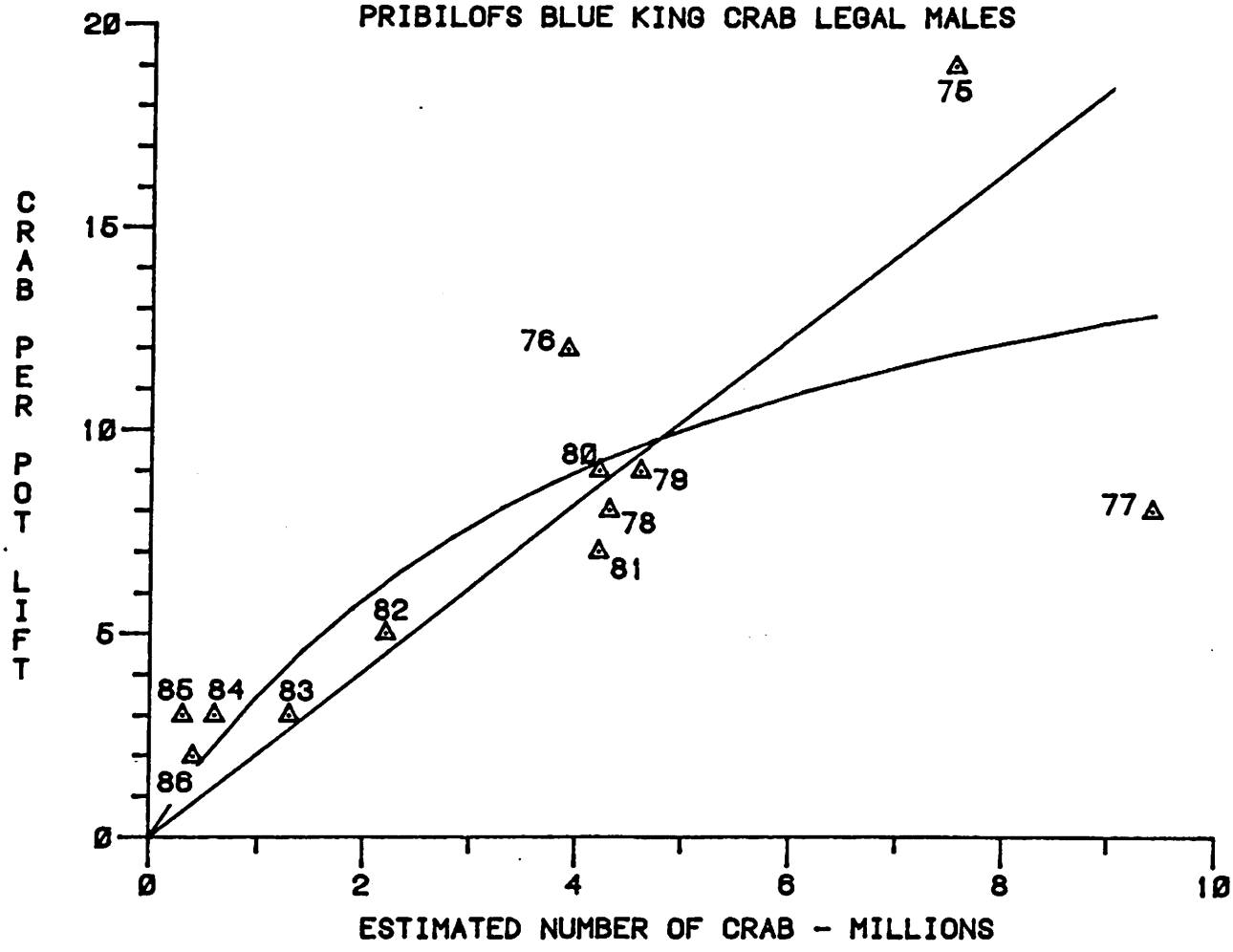



Figure 7. -- Relationship between the average number of Pribilof Island blue king crab (Paralithodes platypus) taken per pot in the U.S. fishery (year shown) and estimates of legal stock size from NMFS trawl surveys in the same year. The curved line assumes some limit to the number of crab a pot could catch.

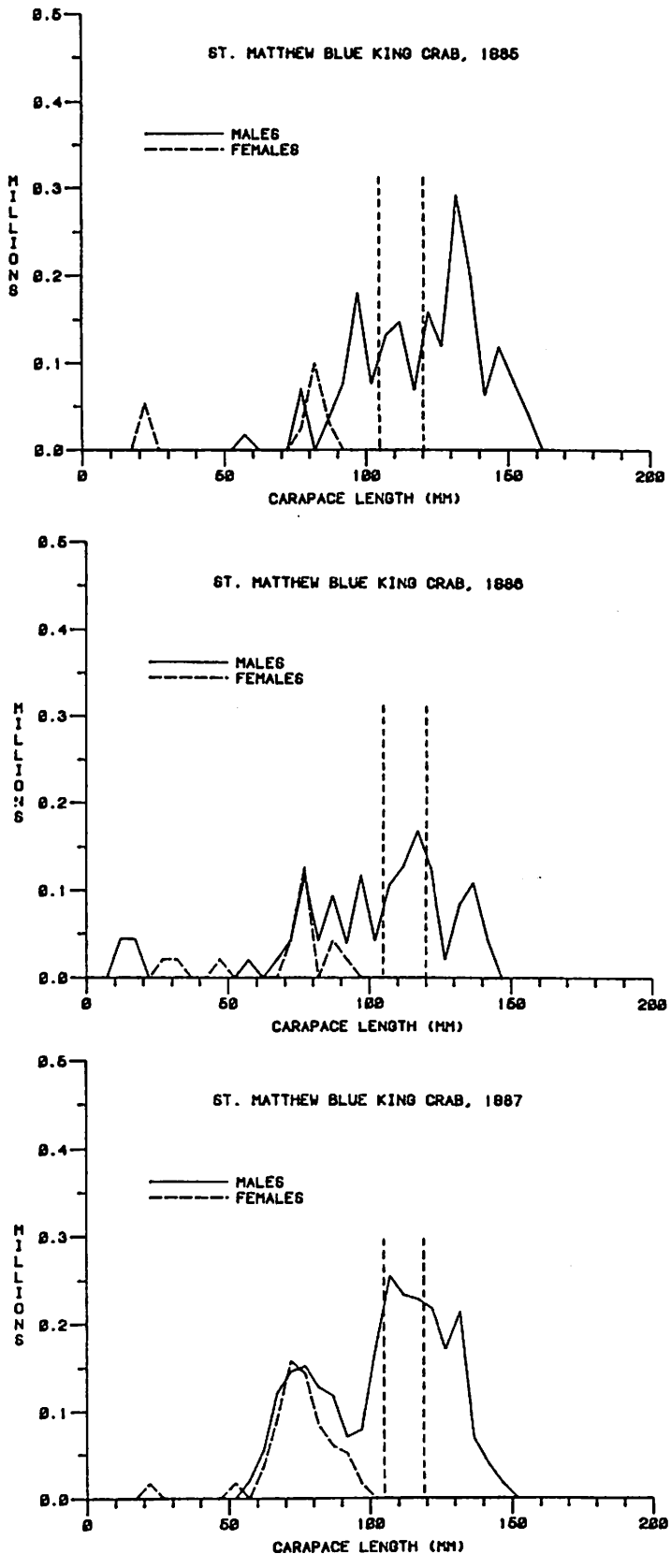



Figure 8. -- Estimates of abundance for male and female St. Matthew Island (Northern District) blue king crab (P. platypus) by 5 mm length classes, 1985-1987. Dashed vertical lines indicate pre-recruit and legal sizes.

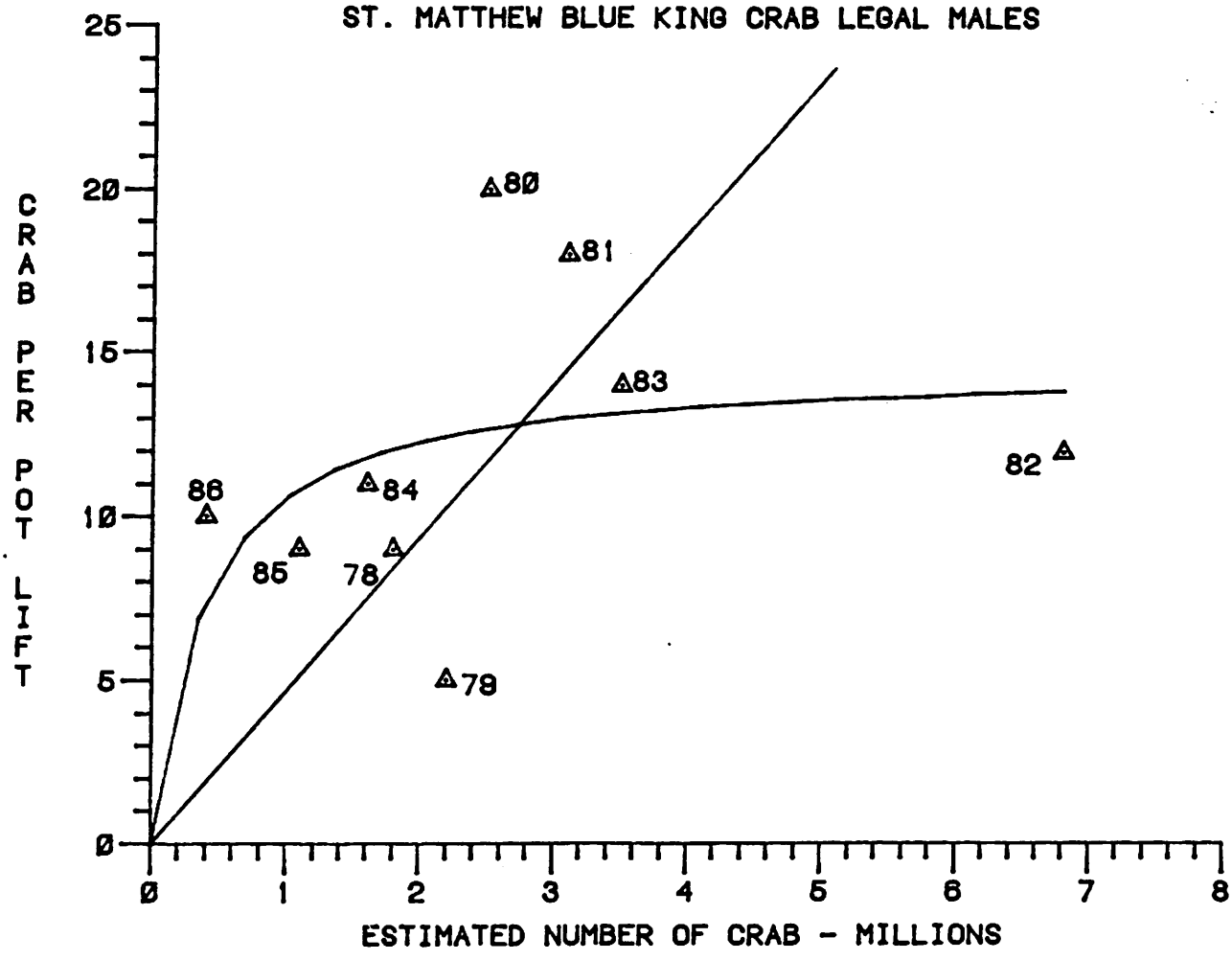



Figure 9. -- Relationship between the average number of St. Matthew Island (Northern District) blue king crab (Paralithodes platypus) taken per pot in the U.S. fishery (year shown) and estimates of legal stock size from NMFS trawl surveys in the same year. The curved line assumes some limit to the number of crab a pot could catch.

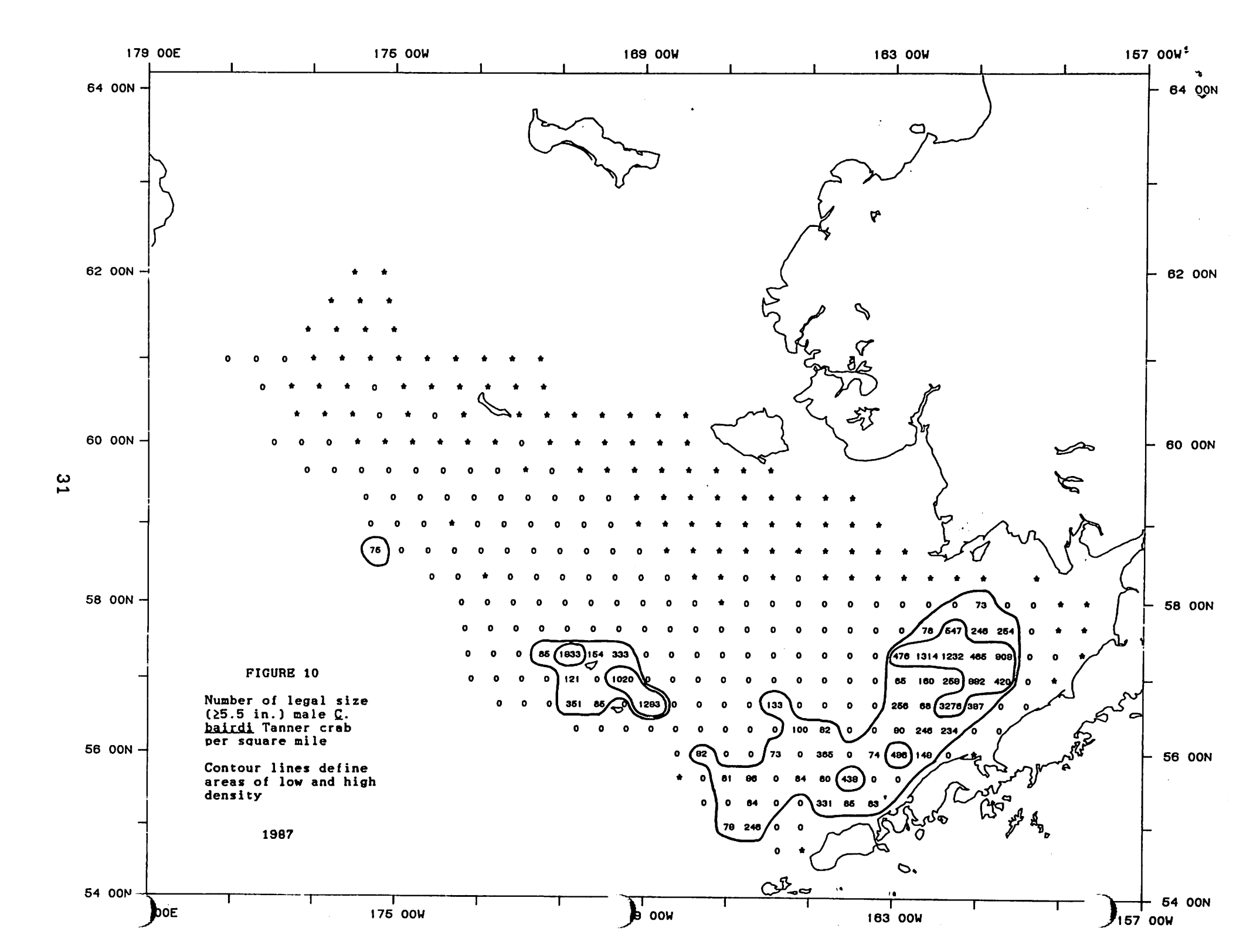



FIGURE 10

Number of legal size (≥5.5 in.) male C. bairdi Tanner crab per square mile

Contour lines define areas of low and high density

1987

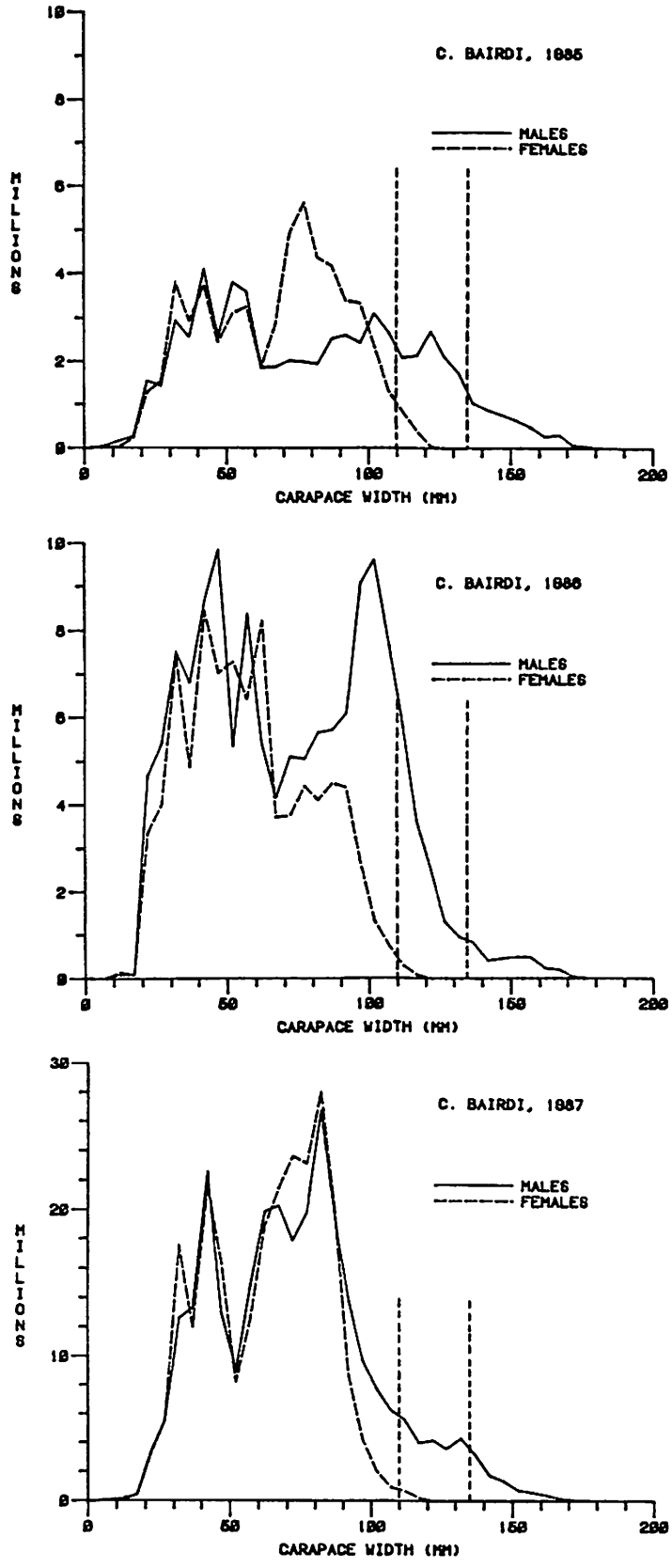



Figure 11. -- Estimates of abundance for male and female C. bairdi in the Bristol Bay and Pribilof Districts, by 5 mm width classes, 1985-1987. Dashed vertical lines indicate pre-recruit and legal sizes. Note difference in vertical scale for 1987.

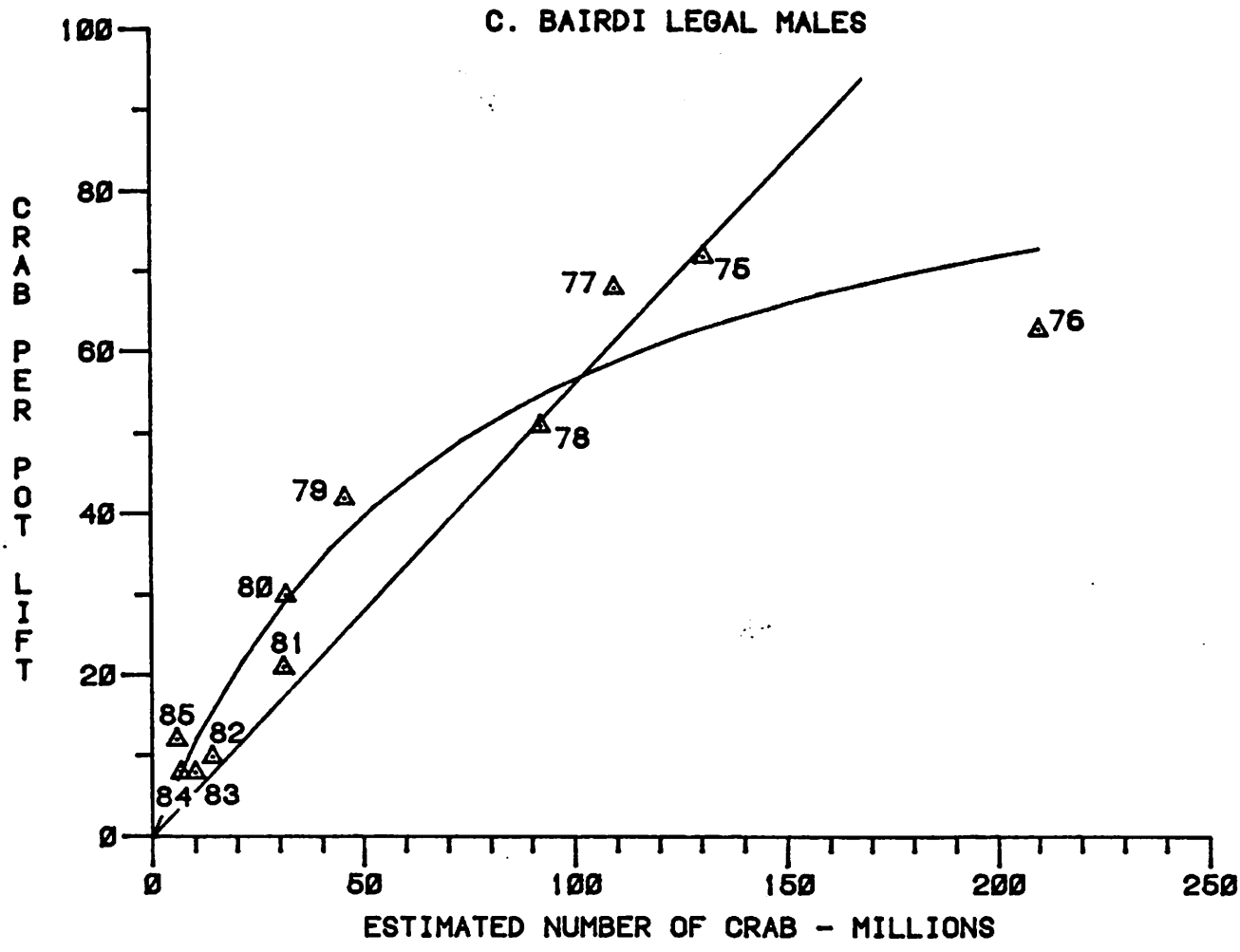



Figure 12. -- Relationship between the average number of tanner crab (Chionoecetes bairdi) taken per pot in the U.S. fishery (year shown) and estimates of legal stock size from NMFS trawl surveys in the preceding year. The curved line assumes some limit to the number of crab a pot could catch.

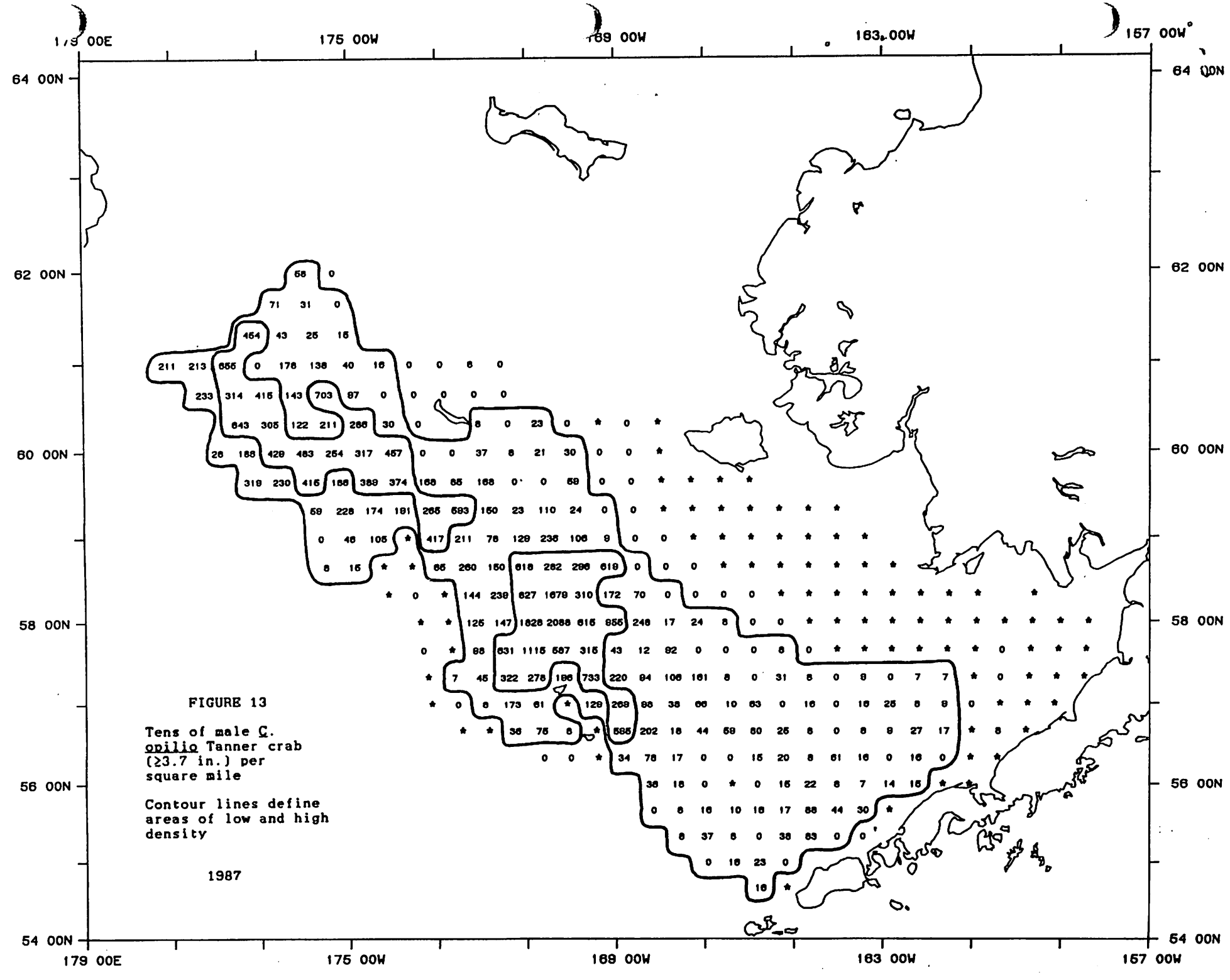



FIGURE 13

Tens of male C. opilio Tanner crab (≥3.7 in.) per square mile

Contour lines define areas of low and high density

1987

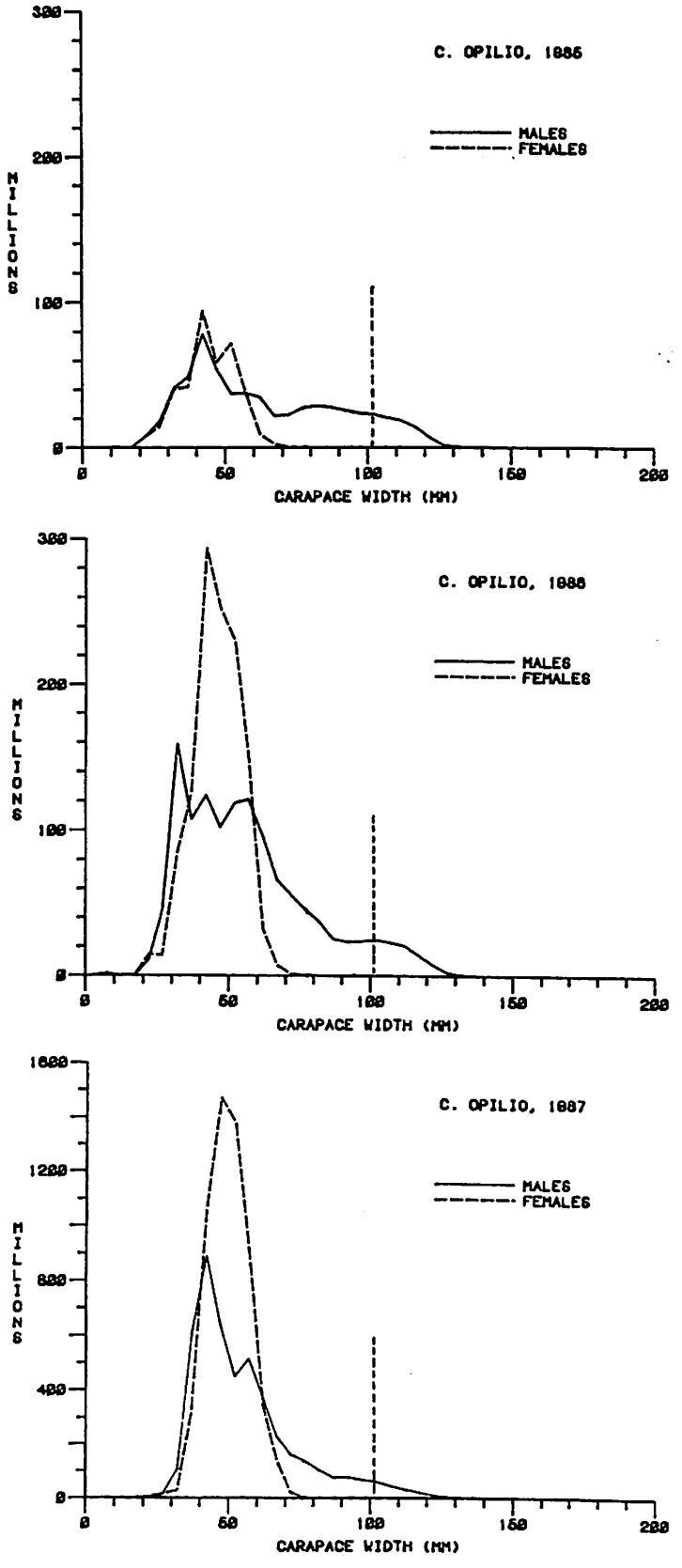



Figure 14. -- Estimates of abundance for male and female C. opilio in the combined Northern, Pribilof and Bristol Bay Districts, by 5 mm width classes, 1985-1987. Dashed vertical line indicates minimum size preferred by industry. Note difference in vertical scale for 1987.

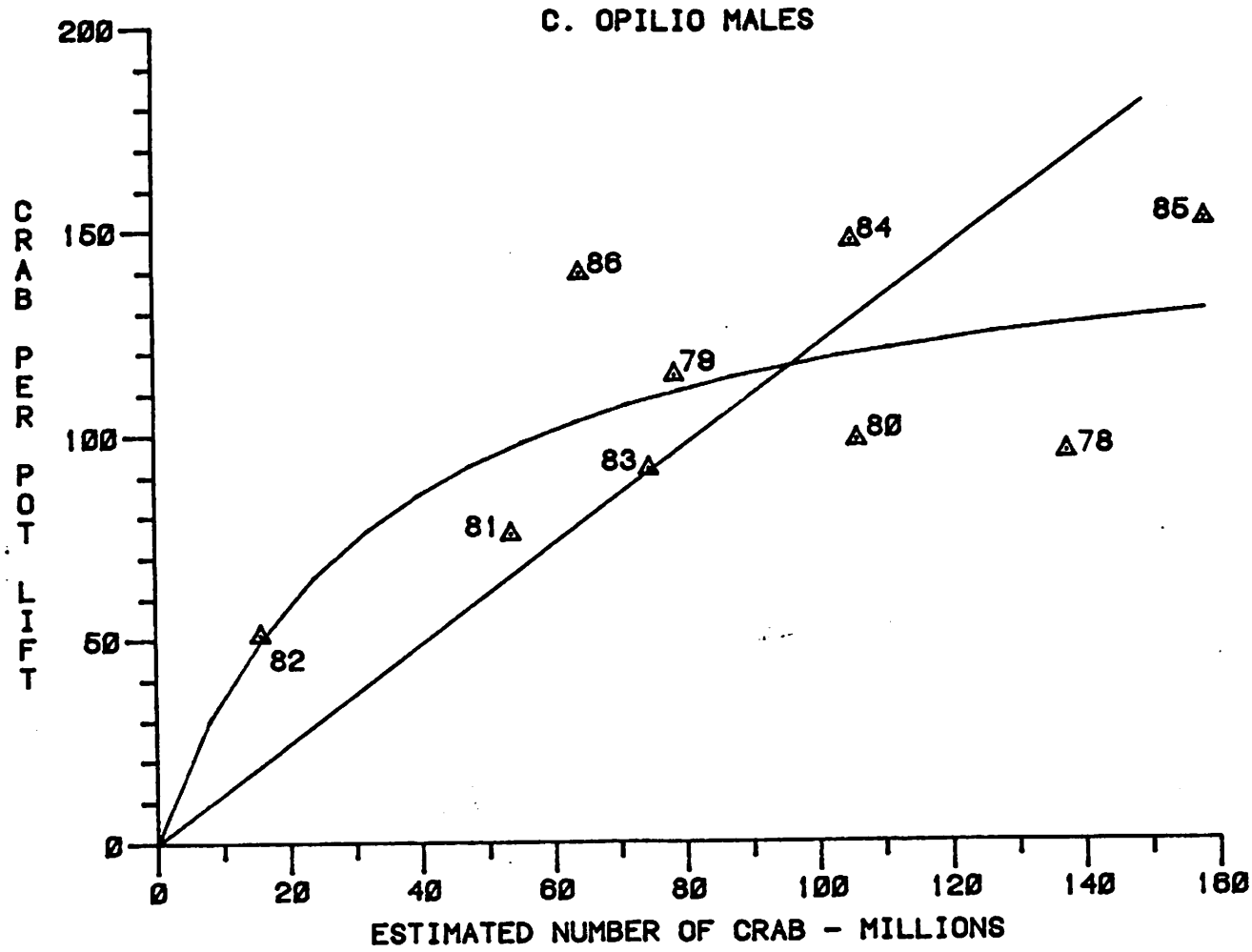



Figure 15. -- Relationship between the average number of tanner crab (Chionoecetes opilio) taken per pot in the U.S. fishery (year shown) and estimates of stock size from NMFS trawl surveys in the preceding year. Population estimates are for males >109 mm (4.3 in) from 1978-1982, ≥95 mm (3.7 in) from 1983 to present, and generally corresponds to minimum harvested size. Data are limited to the Pribilof and Bristol Bay Districts only. The curved line assumes some limit to the number of crab a pot could catch.

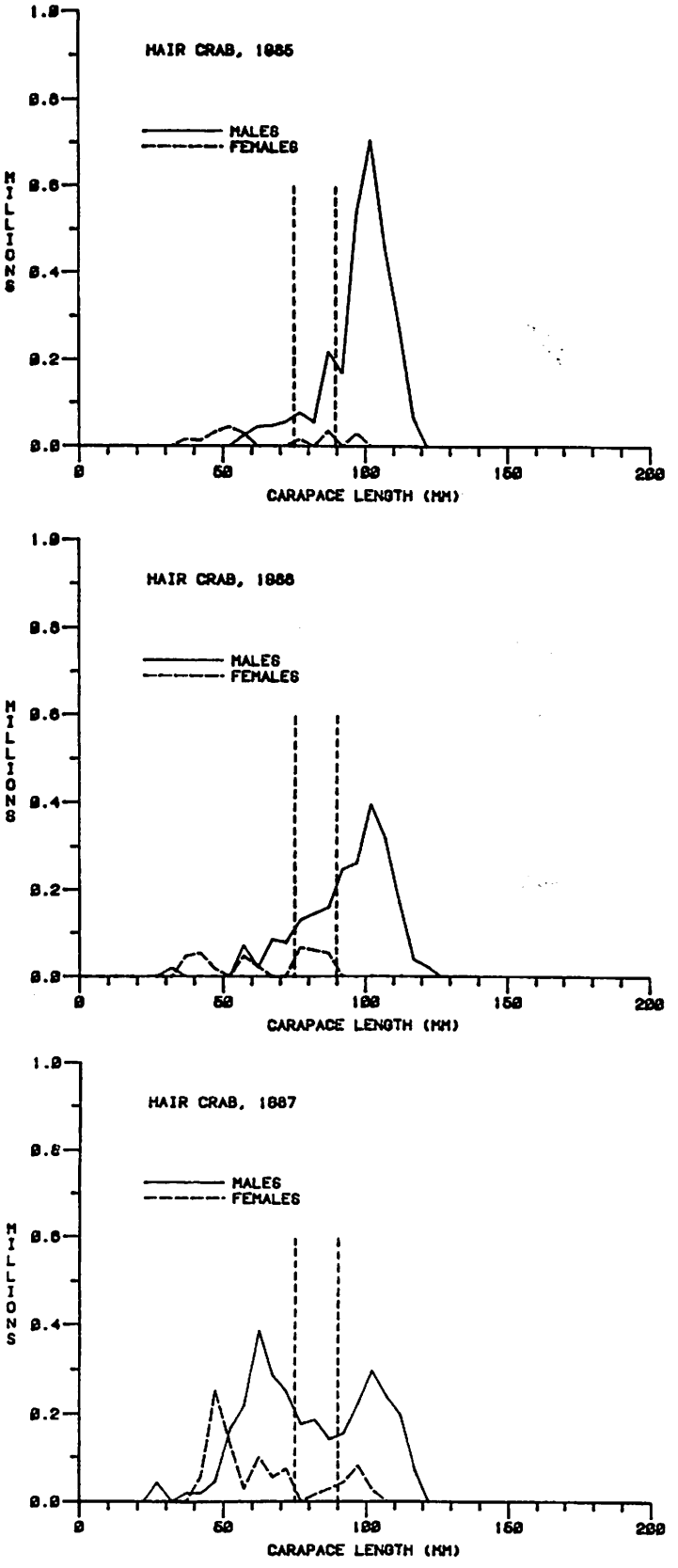



Figure 17. -- Estimates of abundance for male and female hair crab (Erimacrus isenbeckii) in the combined Northern, Pribilof and Bristol Bay Districts, by 5 mm length classes, 1985-1987. Dashed vertical lines indicate pre-recruit and large sizes.