KING AND TANNER CRAB RESEARCH BY THE UNITED STATES
IN THE EASTERN BERING SEA IN 1972

by

Murray L. Hayes and James W. Balsiger

Northwest Fisheries Center
U.S. National Marine Fisheries Service
National Oceanic and Atmospheric Administration
2725 Montlake Boulevard East
Seattle, Washington 98112

September 1972
SCOPE OF U.S. RESEARCH

Responsibility for research by the United States on the king and Tanner crab resources of the Eastern Bering Sea was transferred from the Auke Bay Fisheries Laboratory to the Kodiak Fisheries Laboratory of the Northwest Fisheries Center on July 1, 1972.

Research on king and Tanner crabs in 1972 followed the pattern of recent years. The principal field program was continuation of the annual trawl survey. During June 27 through July 24 the RV Oregon occupied 103 stations on the 20-mile grid pattern used in earlier years (Figure 1). In addition to the data on crabs collected at each station, we also recorded weather and sea conditions; surface and bottom temperatures; surface and bottom salinities; XBT data; zooplankton samples; and data on the marine finfish collected with the crabs.

A U.S. observer was placed aboard the Japanese mothership Koyo Maru on June 17; the ship departed on July 23. His primary assignment was to verify landing statistics of the Japanese fleet and to collect biological measurements in conjunction with the interim measures listed in the appendix to the crab agreement (U.S. Department of State, 1971). Again in 1972 he was unable to do this because of:

1. Restriction of movements aboard the factory ship.
2. Restriction from reviewing the data collected to establish the catch.
3. Restriction from reviewing methods used to collect data in 2.
4. Restriction from reviewing data collected on measurements of king crabs.
Figure 1.—Stations occupied by the NMFS research vessel *Oregon* during the period June 27 to July 24, 1972 in the southeastern Bering Sea.
5. Restriction from reviewing methods of collection of data in 4.

6. Restriction from collection of data to establish independent and comparative estimates of catch of Tanner and king crabs.

7. Restriction from collection of data to establish independent and comparative estimate of size composition of king crabs.

8. Restriction from catcher boats where observations of sorting of soft shell and female crabs might be made.

9. Restriction from catcher boats where observation of mesh size of tangle nets might be made.

He was permitted to make general observations aboard the mothership and he collected data on size composition of certain samples of the catch provided by the Japanese staff aboard the Koyo Maru.

In addition to the field work outlined, analysis of data collected in years past continued. The occurrence and distribution of larval forms of king crabs in about 240 zooplankton samples collected during spring and summer of 1969 and 1970 were described (Haynes, 1972). King crab larvae were most abundant in the southern and eastern areas of Bristol Bay from approximately Amak Island to Port Moller. Highest abundance was near shore; lowest abundance was generally in the central and western parts of the bay. Progression of larval stages corresponded closely with the hypothesized seasonal dispersion of the larvae which was northeastward along the Alaska Peninsula toward the head of Bristol Bay. The seasonal dispersion of the larvae agrees with known patterns of water movement in the study area. In addition a preliminary equilibrium sustained yield model for the king crab fishery of the southeastern Bering Sea was developed (Greenough, 1972).
This is a yield per recruit type model (Ricker, 1958) which uses estimates of recruitment from the annual trawl surveys to predict an annual yield of 3-5 million king crabs.

**DISTRIBUTION AND RELATIVE ABUNDANCE OF CRABS IN 1972**

**King crabs**

The trawl survey in 1972 included 103 stations in the southeastern Bering Sea which included the area where king crabs have been found in past surveys. The stations along the eastern and northern boundary of the area sampled contained approximately 5% of the king crabs caught, but shallow water and proximity of land suggest that the portion of the population not sampled in these directions was small.

The distribution and relative abundance of male king crabs over 120 mm in carapace length during the 1972 trawl survey are plotted in Figure 2. The numbers on this and subsequent figures are the actual catches made, expanded by the area swept by the research trawl to number of crabs per square mile. The squares on these figures represent the 400 square miles surrounding each trawl station. The distribution of large male crabs in 1972 was similar to those for other trawl surveys in recent years. Large males were distributed throughout the survey area and their distribution extended north of the Fox Islands—beyond the distribution of females and juveniles.

The distribution and relative abundance of male king crabs less than 120 mm in carapace length is shown in Figure 3.
Figure 2.—Distribution of large male king crabs, *P. camtschatica*, (carapace length ≥ 120 mm) in the southeastern Bering Sea in 103 trawl catches, May 27 to July 24, 1972.
Figure 3.--Distribution of male king crabs, \textit{P. camtschatica}, less than 120 mm in carapace length in 103 trawl catches in the southeastern Bering Sea.
The distribution and abundance of large female king crabs (carapace length ≥ 100 mm) are plotted in Figure 4. The distribution is similar to that found in the 1969-71 surveys. In general, large females were found with large males in shallow waters adjacent to the Alaska Peninsula in the portion of Bristol Bay southeast of a line connecting Cape Newenham and Akutan Island.

The distribution and relative abundance of juvenile king crabs (carapace length smaller than 100 mm) are plotted in Figures 5 and 6. The distribution is similar to that found in earlier surveys. Generally, juveniles were distributed in the portion of Bristol Bay southeast of a line from Cape Newenham to Akutan Island with concentrations north of Unimak Pass, northeast of Amak Island, and north of Port Moller.

**Tanner crabs**

The distribution and relative abundance of Tanner crabs are plotted in Figures 7, 8, and 9 for *Chionoecetes bairdi* and Figures 10 and 11 for *C. opilio*. Crabs with characteristics intermediate between the two species, which may be hybrids, were again identified in 1972 but their abundance constituted only about 1% of the Tanner crabs examined. A separate analysis of the possible hybrid situation is being made.

The distribution and relative abundance of male *C. bairdi* are shown in Figure 9. *C. bairdi* males larger than 130 mm in carapace width (Figure 7) were scarce in the 1972 trawl survey catches. Those found were distributed north of the Alaska Peninsula in the same general area as large king crabs except that their distribution also extended westward of that for king crabs north of the Fox Islands.
Figure 4.—Distribution of large female king crabs, *P. camtschatica*, (carapace length ≥ 100 mm) in the southeastern Bering Sea in 103 trawl catches.
Figure 5.—Distribution of male king crabs, P. camtschatica, less than 100 mm in carapace length.
Figure 6.--Distribution of female king crabs, *P. camtschatica*, less than 100 mm carapace length.
Figure 7.--Distribution of male Tanner crabs, *C. bairdi*, greater than 130 mm in carapace width in 103 trawl catches in the southeastern Bering Sea.
Figure 8. -- Distribution of female Tanner crabs, *C. bairdi*, greater than 80 mm in carapace width in 103 trawl catches in the southeastern Bering Sea.
Figure 9.—Distribution of male Tanner crabs, C. bairdi, in 103 trawl catches in the southeastern Bering Sea.
Figure 10.--Distribution of male Tanner crabs, *C. opilio*, in 103 trawl catches in the southeastern Bering Sea.
Figure 11.--Distribution of female Tanner crabs, *C. opilio*, in 103 trawl catches in the southeastern Bering Sea.
C. bairdi females larger than 80 mm in carapace width (Figure 8) were generally distributed in the same area as large males.

Distribution and relative abundance of C. opilio males are plotted in Figure 10 and those for females are plotted in Figure 11. C. opilio was found generally north and west of the distribution of C. bairdi.

ABUNDANCE OF CRABS IN RECENT YEARS

King crabs

The estimates of relative abundance presented earlier in this report were expanded to population estimates using the techniques described in earlier reports (Hoopes and Greenough, 1970). The 1972 estimates are compared with the estimates obtained from the spring surveys of 1968, 1969, and 1970. No total population estimates are made for the 1971 trawl survey since the effort in that year was geographically expanded to better define the western and northern limits of the C. bairdi population which reduced the number of trawl hauls made in the areas of earlier surveys for king crabs. Karinen (1972) has compared both experimental trawl CPUE for stations fished in both 1970 and 1971. No significant difference in CPUE was found between the 2 years for those stations which produced king crabs in both years.

Figures 12 and 13 are graphs that present estimates of male and female king crab abundance by millimeter length classes for the spring-summer trawl cruises in 1968, 1969, 1970, and 1972. Tables 1 and 2 provide abundance estimates for male and female king crabs respectively.
Figure 12.--Estimates of male king crab abundance by 10 mm length classes for the 1968, 1969, and 1970 spring research cruises in the eastern Bering Sea.
Figure 13.--Estimates of female king crab abundance by 10 mm length classes for the 1968, 1969, and 1970 spring research cruises in the eastern Bering Sea.
Table 1.—Estimated abundance of mature female king crabs (90-mm carapace length or greater) from trawl survey data taken in the spring of 1968, 1969, 1970, and 1972.

<table>
<thead>
<tr>
<th>Year</th>
<th>Estimated abundance (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1968</td>
<td>53.7</td>
</tr>
<tr>
<td>1969</td>
<td>28.4</td>
</tr>
<tr>
<td>1970</td>
<td>12.9</td>
</tr>
<tr>
<td>1972</td>
<td>13.6</td>
</tr>
</tbody>
</table>
Table 2.—Estimated abundance of male king crabs in the eastern Bering Sea based upon U.S. research vessel trawl surveys in the spring of 1968, 1969, and 1970.

<table>
<thead>
<tr>
<th>Year</th>
<th>&lt; 120 mm</th>
<th>≥ 120 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1968</td>
<td>22.2</td>
<td>18.7</td>
</tr>
<tr>
<td>1969</td>
<td>51.8</td>
<td>19.5</td>
</tr>
<tr>
<td>1970</td>
<td>16.3</td>
<td>10.5</td>
</tr>
<tr>
<td>1972</td>
<td>19.7</td>
<td>10.6</td>
</tr>
</tbody>
</table>
Tanner crabs

Abundance estimates of large male *C. bairdi* have shown a marked decline between 1968 and 1972. Figure 14 contrasts estimates of abundance of male *C. bairdi* by 5-mm width increments for 1970, and 1972.

Table 3 compares the catch per standard trawl haul for *C. bairdi* for crabs over 130 mm in carapace width for 1969-72. These data indicate a precipitous decline in the abundance of large Tanner crabs.
Figure 14.--Estimates of male *C. bairdi* abundance by 5-millimeter width classes for the southeastern Bering Sea based on samples collected during 1970 and 1972 trawl surveys.
Table 3.—Catch per standard trawl haul of male *C. bairdi* (over 130 mm in carapace width) taken in spring surveys, 1969-72.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. stations fished</th>
<th>Stations with lg. <em>C. bairdi</em></th>
<th>Total catch</th>
<th>CPUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1969/</td>
<td>772/</td>
<td>64</td>
<td>8564</td>
<td>133.8</td>
</tr>
<tr>
<td>1970</td>
<td>782/</td>
<td>72</td>
<td>2992</td>
<td>41.6</td>
</tr>
<tr>
<td>1971</td>
<td>51</td>
<td>28</td>
<td>314</td>
<td>11.2</td>
</tr>
<tr>
<td>1972</td>
<td>103</td>
<td>52</td>
<td>335</td>
<td>6.4</td>
</tr>
</tbody>
</table>

1/ In 1969 Tanner crabs were not identified by species. Data of other years suggest that less than 1% of *C. opilio* crabs caught are larger than 130 mm in carapace width. Because data in this table is for crabs over 130 mm, it was assumed that those crabs recorded here for 1969 were *C. bairdi*.

2/ Excludes replicate samples.
TRENDS IN THE COMMERCIAL FISHERIES

In 1971 Japan continued to shift emphasis from king crabs to Tanner crabs, influenced in part by the reduction of her quota for king crabs from 85,000 cases in 1970 to 37,500 cases in 1971. Japan's 1971 Tanner crab catch was also lower (by 14%) than her 1970 catch. The U.S. 1971 king crab harvest increased by more than 50% (in weight) over her 1970 catch and reached an all time high for the Bering Sea. Simultaneously, the U.S. 1971 Tanner crab fishery exerted the lowest level of effort since 1968, resulting in a reduction in catch of 87%, the lowest level of Tanner crab production by the United States since the Tanner crab fishery was initiated in 1968. (The information in this section is from the Fisheries Agency of Japan, 1971a, 1971b, 1972a, 1972b, 1972c, 1972d; Hoopes and Greenough, 1970; Hoopes et al., 1971; Hoopes, Karinen, and Pelto, 1972; and Jackson, in press.)

No information is available on the 1971 Soviet Union crab fisheries in the Bering Sea.

United States

The U.S. harvest of king crabs in the eastern Bering Sea during 1971 was 2,404,681 crabs, an increase of 43% over the 1970 catch and an all time high for the United States in the Bering Sea (Figure 15). The total U.S. effort also reached a new high level, but the long declining CPUE reversed its trend, increasing to 20.3 crabs per pot from 17.4 crabs per pot in 1970 (Figure 15). Figure 16 shows the frequency distribution for 10-mm size groups of the U.S. commercial catch for 1969 to 1971.
Figure 15. -- U.S. commercial fishery for king crab.
Figure 16.—Size frequency distribution of U.S. commercial catch of king crab.
The distributions in 1969 and 1970 were remarkably similar, whereas a slight shift to the right in 1971 probably resulted from a combination of the exploitation of new fishing grounds and a new minimum size limit imposed in 1971.

The U.S. Tanner crab production dropped from a high of 482,307 crabs in 1970 to 61,347 crabs in 1971 (Figure 17). The decline in CPUE (from 29.5 crabs per pot in 1970 to 8.5 crabs per pot in 1971) for Tanner crabs reflects the fact that an undetermined large portion of the Tanner crab fishery is based on the incidental catch of king crab efforts and does not necessarily demonstrate a decline in the Tanner crab population. The average weight per Tanner crab in 1971 was 1.2 kg, down from 1.3 kg in 1970.

Japan

Japan filled her 1971 quota of 37,500 cases with a catch of 885,620 king crabs, of which 21% were caught by tangle nets. In 1970, Japan filled her quota of 85,000 cases with a catch of 2,080,400 crabs, of which 88% were caught in tangle nets. The trend toward an exclusive pot fishery is expected to continue in 1972 and be completed as tangle nets are completely phased out in 1973. King crab CPUE values for tangle nets dropped from 7.3 in 1970 to 6.7 crabs per tan in 1971 (Figure 18) but went up from 0.3 to 0.6 king crabs per pot in 1971 for the pot fishery. The CPUE values become increasingly less meaningful as indicators of stock condition as a larger percentage of the total king crab catch is taken incidentally by the effort directed at Tanner crabs. The average size of a king crab in the catch decreased from 145.0 mm (carapace length) in 1970 to 144.5 mm in 1971 (Figure 19).
Figure 17.--U.S. commercial fishery for Tanner crab.
Figure 18.--Japanese commercial fishery for king crab.
Figure 19.--Size frequency distribution of Japanese commercial catch for king crab.
The Japanese Tanner crab catch decreased from 18,190,000 crabs in 1970 to 15,738,800 crabs in 1971. Of the Tanner crabs processed in 1971, 95% were taken by the pot fishery, compared with 58% in 1970. The catch per unit effort in Japan's Tanner crab pot fishery remained nearly unchanged in 1971 (13.40 crabs per pot vs 13.19 crabs per pot in 1970)(Figure 20). The average size of Tanner crabs has declined from 159.7 mm (carapace width) in 1970 to 155.8 mm in 1971.

LITERATURE CITED


Figure 20.--Japanese commercial pot fishery for Tanner crab.


