Trend and status of the tanner crab resource and its utilization in the eastern Bering Sea

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Fishery Agency of Japan
It is generally recognized among both U.S. and Japanese scientists that stocks of Tanner crab in the eastern Bering Sea have been in very healthy condition, as evidenced by fishing records and the results of the U.S. trawl surveys conducted since 1973 (INPFC Doc. 1931, 2025). Under such circumstances, commercial harvests of Tanner crabs have been far below optimum catch levels (INPFC Doc. 2025).

In this document, some observations are made on minimum size limits, exploitation rates and the Acceptable Biological Catch (ABC) of Tanner crabs on the basis of scientific information and statistical records available to both U.S. and Japanese scientists.

**Minimum Size Limits:**

Figure 1 shows the carapace width composition of adult female Tanner crabs, supported by Japanese trawl survey results in the eastern Bering Sea. It may be observed that adult female crabs of both C. bairdi and C. opilio form two modal groups. The ages at which Tanner crabs reach such modal groups are estimated, respectively, at between 7-8 years (for C. bairdi) and 6-7 (for C. opilio).
As male crabs also are believed to require a similar length of time to attain maturity, it would be reasonable to assume that the ages at maturity for males are likely to be 7-8 years (C. bairdi) and 6-7 (C. opilio), which correspond to carapace widths of 90-105 mm and 55-65 mm respectively.

Somerton and Low (1977) state:

"It appears that it is rational to harvest male C. bairdi when it is about 123 mm carapace width (9.3 years old) at a reasonable fishing intensity to achieve a high value for Y/R when M = 0.2."

Accordingly, we are theoretically led to believe that there is a rationale for starting the harvesting of male Tanner crabs when they reach 123 mm carapace width.

U.S. authorities, on the other hand, have taken an unduly conservative approach, setting the minimum size limit at 140 mm (135 mm in biological measurement) in the proposed FMP, on the grounds of certain reservations on use of the Y/R model itself (because of its preliminary nature) and the lack of definitive knowledge on the extent of participation of the larger-size male in the spawning of the female.

In our opinion, however, it appears quite reasonable to set the minimum size limit at 130 mm for C. bairdi (10 years old) and 90 mm for C. opilio (9 years old). With these minimum size limits, sufficient reproduction potentials can be maintained, considering that, as already mentioned, the estimated ages at which
male crabs attain maturity are 7-8 years for C. bairdi and 6-7 for C. opilio and that:

"...some males possibly mating with several females"; and

"...female Tanner crabs can store sperm, possibly for a number of years, and therefore need not find mates each breeding season."

(Somerton and Low, op. cit.)

Exploitation Rates:

U.S. scientists, in their reply to comments made by the Japanese Fishery Agency in February, 1978, concerning the exploitation rate for C. bairdi, explicitly stated:

"The theoretical yield per recruit analysis indicates an exploitation rate of 0.7 at the minimum size of 135 mm."

Nevertheless, under the proposed FMP, the rate is set at 0.4.

Whatever the problems involved in the estimation of exploitation rates, it seems that the value of 0.7 is the best available to date and, therefore, we think it would be more reasonable for the U.S. to use this figure at a minimum size of 135 mm.

Japanese scientists consider 130 mm as an appropriate minimum size limit for C. bairdi and, accordingly, the optimum exploitation rate should not be set below 0.6. Similarly, for C. opilio, we believe the optimum exploitation rate should be set above 0.6 at a minimum size of 90 mm.
Stock Conditions:

Through U.S. trawl surveys conducted during 1974-1977, it was found that the biomass of male C. bairdi larger than 130 mm in carapace width ranged between 110 - 160 million crabs in all years excepting 1975 which showed an unusually high value (cf. Table 1).

During this period, very little change was recorded in the CPUE (Catch per Unit Effort) of U.S. Tanner crab fisheries, while in the Japanese fisheries a slight decline was noted in CPUE in Area A during 1977. This decline might be attributed to the difficulties faced by Japanese fishermen in coping with the new regulations implemented during the year under the Fishery Conservation and Management Act of 1976. The major fishing grounds of the Japanese Tanner crab fisheries prior to 1977 were closed by these regulations, particularly those in which a high concentration of C. bairdi had long been experienced. It is not reasonable, therefore, to think that the lower CPUE in Area A in 1977 reflects a lesser abundance of Tanner crab resources (cf. Table 2).

Data are available which adequately indicate that the biomass of C. bairdi has been at a consistently high level over the past several years. And the tagging experiments of Japanese research vessels in 1977
also suggest that the abundance of C. bairdi is at as high a level as in 1971 (INPFC Doc. 1993).

Although U.S. scientists explain that the CPUE of U.S. Tanner crab fisheries toward the end of May, 1978 is somewhat lower than in the comparable period of last year, we do not consider it reasonable to deduce a decline in crab abundance directly from the lower 1978 CPUE of U.S. fisheries, since it is possible that unusual environmental conditions in the ocean during 1978 may have affected the availability of Tanner crab.

The status and trends of C. opilio stocks are considered stable (INPFC Doc. 1993) on the basis of Japanese fishery statistics in Area B, in which C. opilio comprise approximately 60% of the catch. This indicates a stable CPUE since 1975 and no specific change in carapace width composition.

Acceptable Biological Catch:

As already discussed, Tanner crab stocks in the eastern Bering Sea seem to retain a high level of abundance at present, and for 1978 and 1979 an average abundance level may be expected.

When we project the biomass for 1979 from the average value of the estimated biomass of large-size male Tanner crab for 1976-1977, as taken in the U.S. trawl surveys, a figure of approximately 135 million C. bairdi (≥ 130 mm) is developed. Even when we apply a very
conservative exploitation rate of 0.6 to this estimated biomass, the ABC of C. bairdi for 1979 should be set at least at 81 million crabs.

Based on their analysis, Japanese scientists are convinced that present utilization of both C. bairdi and C. opilio is below the biological optimum suggested by ABC estimates.
TABLE 1.
ANNUAL ABUNDANCE ESTIMATES FOR TANNER CRABS FROM RV OREGON SURVEYS IN THE EASTERN BERING SEA

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>(mm)</td>
<td>(In Millions of Crabs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. bairdi</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>&gt;129</td>
<td>130.5</td>
<td>209.6</td>
<td>157.8</td>
</tr>
<tr>
<td>Legal Males</td>
<td>97 *</td>
<td>175 *</td>
<td>109.4</td>
<td>92.1</td>
</tr>
<tr>
<td>C. opilio</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>&gt;99</td>
<td>371 *</td>
<td>449 *</td>
<td>276 *</td>
</tr>
<tr>
<td>&gt;109</td>
<td>246.7</td>
<td>274.8</td>
<td>181.6</td>
<td>137.3</td>
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Source: INPFC Doc. 2024

* These figures were not available in the original table but were taken from Figs. 27 and 29 of Doc. 2024.

TABLE 2.
ANNUAL CATCH STATISTICS AND CPUE IN AREA A (EAST OF 168° W) FOR THE JAPANESE TANNER CRAB FISHERY

<table>
<thead>
<tr>
<th>Year</th>
<th>Catch (000 crabs)</th>
<th>CPUE</th>
<th>Area Fished in 1977</th>
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<tr>
<td>1973</td>
<td>5,992.0</td>
<td>11.3</td>
<td>56° N - 56° 30' N, 164° 00' W - 165° 30' W</td>
</tr>
<tr>
<td>1974</td>
<td>5,999.0</td>
<td>13.8</td>
<td></td>
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<tr>
<td>1975</td>
<td>2,180.8</td>
<td>14.1</td>
<td></td>
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<tr>
<td>1976</td>
<td>2,434.2</td>
<td>13.8</td>
<td></td>
</tr>
<tr>
<td>1977</td>
<td>2,452.8</td>
<td>12.8</td>
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</tbody>
</table>
Fig. 1. Carapace width composition of adult (ovigerous) female tanner crabs, based on 1966 and 1973 Japanese trawl surveys in the eastern Bering Sea.