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Reprinted from the
Alaska Fishery Research Bulletin
Vol. 6 No. 2, Winter 1999

The Alaska Fishery Research Bulletin can found on the World Wide Web
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Alaska Fishery Research Bulletin 6(2):94–103. 2000.

Capture Efficiency and Size Selectivity of Two Types of Pots for Red King Crabs in the Bering Sea

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ABSTRACT: We compared the catch efficiency and size selectivity of experimental and standard king crab pots in Bristol Bay in the eastern Bering Sea in 1996. The experimental pot was intended to selectively catch legal-sized (carapace width ≥165 mm) male red king crabs and reduce the catch of smaller (<165 mm) crabs. Mean catch per pot haul (CPUE) for legal male red king crabs was 25.3 (SD = 7.9) for standard pots and 20.5 (SD = 8.5) for experimental pots. Mean CPUE of all crabs combined was 63.3 (SD = 26.0) for standard pots and 55.0 (SD = 28.1) for experimental pots. We found no statistically significant differences in CPUE ($P > 0.05$) except standard pots caught significantly more crabs ≥130 mm carapace length in 3 of 6 fishing locations than experimental pots. When CPUE was standardized by effective pot volume, the experimental pots had significantly higher catch per unit of volume for all crab groups than the standard pots. Female and small male crabs remained in both pots during the 2-d soak time even though they were capable of leaving.

INTRODUCTION

Current regulations for the red king crab *Paralithodes camtschaticus* (Tilesius 1815) fishery in Bristol Bay, Alaska, allow only male crabs ≥165 mm (minimal legal size) in carapace width (CW) or ≥137 mm in carapace length (CL) to be retained. Male crabs smaller than 165 mm CW when they are caught are referred to as sublegal crabs and must be returned to the water along with all female crabs. Zhou and Shirley (1996) estimated 65% of the catch was discarded during the 1990–1993 red king crab fisheries in the eastern Bering Sea. Fishers and management agencies both want to reduce the catch of nonlegal crabs. High rates of sorting, lower fishing efficiency, and handling and discarding may damage crabs returned to the sea (Kruse 1993). Increased catch of legal-sized males would improve economic performance by reducing the number of pot lifts needed to achieve the catch quota, but higher catch rates would diminish the Alaska Department of Fish and Game's (ADF&G) ability to manage the catch within small quotas. For example, higher-than-expected mean catch rates in 1996 led to management error; the 2,270-ton quota was exceeded by 1,544 tons during a 5-d fishery in Bristol Bay.

King crab pots are metal frames covered with mesh webbing. Crab pots of different sizes and shapes have been used by king crab fishermen, but box-shaped pots are considered the standard king crab pot in the commercial fishery. Three common sizes of pots have bases of 198 × 198 cm, 213 × 213 cm, and 244 × 244 cm and heights of 70 to 99 cm. Stretch mesh sizes (the length of 2 adjacent sides of a mesh) vary from 90 to 200 mm (High and Worlund 1979). To reduce bycatch of small crabs, fishery regulations since 1993 have required each king crab pot to have at least one-third of one vertical surface of the pot composed of webbing ≥230 mm stretch mesh. Because the fishery was closed in 1994 and 1995, this new requirement had not been applied before our experiment.

Based on higher catch rates for legal males in a laboratory study (Zhou and Shirley 1997a), we designed an experimental pot to increase the entry of crabs of all sizes and both sexes and increase the es-

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Acknowledgments: D. Pengilly, D. Tracy, L. Boyle, R. Morrison, and S. Byersdorfer — valuable assistance in experimental design, field work, and data entry. D. Tracy — essential help in pot construction, gear transportation, arrangement of field work, and data compilation, for which we are especially grateful. The crew of F/V *Rosie G* — work at sea. Kristin Mabry — cartography.
Project Sponsorship: This study was funded by ADF&G, Division of Commercial Fisheries, in part by a cooperative agreement with the National Oceanic and Atmospheric Administration. The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its sub-agencies or ADF&G.

Table 1. Location, mean depth, soak time, and the actual number of pots fished in 6 blocks in Bristol Bay in the Bering Sea. The actual number of pots was less than 16 in some blocks due to gear malfunctions (e.g., no bait, door opened).

	Location		Depth	Soak Time (h)		Number of Pots	
Block	Latitude	Longitude	(m)	Mean	SD	Standard	Experimental
1	56°53′51″N,	163°14′99″W	65.8	50.3	1.3	7	8
2	56°39′51″N,	162°31′05″W	73.2	38.6	0.6	8	7
3	56°39′50″N,	162°34′12″W	73.6	48.5	1.5	7	7
4	56°34′50″N,	163°01′68″W	76.0	38.5	1.1	7	8
5	56°45′48″N,	163°06′99″W	68.6	36.2	0.5	8	8
6	56°53′50″N,	163°12′01″W	64.0	97.4	0.4	8	8

cape of females and small males. We tested our experimental pot in Bristol Bay in the eastern Bering Sea to compare its performance with standard king crab pots. In this paper, we compare mean catch per pot haul (CPUE) and size composition of red king crabs captured in the 2 types of pots.

METHODS

King crab pots

Standard king crab pots used in this experiment had been previously used in the fishery. They measured 213 × 213 × 86 cm, and had 2 tunnels at opposite ends. Each pot had 2 side panels, 1 top panel, and 1 bottom panel (Figure 1). One side panel functioned as the door through which the pot was baited and crabs were removed. The tunnels tapered inward and upward from their base to horizontal tunnel eye openings of 91 × 20 cm. The height of the lower edge of the tunnel eye was 45 cm from the bottom panel. The effective volume (space below entrances) was approximately 1.70 m^3. The metal frame of the pot was wrapped with 90-mm stretch mesh, except that half of one side panel was 240-mm mesh webbing in accordance with recent regulation. This large mesh was fitted vertically on either half of the panel or horizontally on the lower half of the panel.

The experimental pots had the same dimensions as the standard pots, but several features differed from the standard pot (Figure 1). Instead of 2 tunnels, the experimental pots had 4 tunnels each tapering inward and upward and traversing the entire width of the side panels. This provided a continuous opening around the pot, providing crabs easy entry regardless of the direction of approach and ocean currents. Each of the 4 openings was 14 cm in height and was 25 cm from the bottom panel. The total area of the 4 openings was about 9,700 cm^2, compared to 3,640 cm^2 for the standard pot. The effective volume of the pot was approximately 0.84 m^3, which was 0.49 times that of the standard pot. Because of the low tunnel entrance, the experimental pot had more space above the entrance. The height of the experimental pot was reduced from the standard pot by 25% on the original design plan; thus, the real size of the experimental pot would be 25% smaller than the standard pot. However, to reduce costs, we built the experimental pots by using used frames of standard pots. The entrance opening was furnished with inward opening triggers spaced 10 cm apart. Although crabs of any size could enter the pot, the distance between adjacent triggers and the height of the entrance allowed crabs smaller than minimum legal size to escape between the triggers. The low entrance was intended to provide legal-sized crabs easy entry into the pot, and small crabs easy exit. The metal frame of the pot was wrapped with 90-mm mesh webbing, except 240-mm mesh was used above one tunnel to comply with fishing regulations. Experimental pots were constructed of new materials.

Field experiment

We conducted the experiment in Bristol Bay (Figure 2) during August 14–28, 1996, before the commercial fishery opening. The experiment was conducted from a chartered fishing vessel, and commercial fishermen were employed to fish the pots. Our experimental design involved 6 blocks each consisting of 16 pots, 8 standard and 8 experimental (Table 1). The 16 pots in a block were evenly spaced in a 4 × 4 grid (1 × 1 nautical mile); pots were about 617 m apart. Standard and experimental pots were alternated in the block to minimize potential row and column effects on capture efficiency (Figure 2).

Pot depth ranged from 64.0 to 76.8 m (mean = 70.2 m). The sea floor was essentially flat with a sandy mud substrate. Pots were baited with chopped frozen herring in a 1-L perforated plastic container suspended from the center of the pot. No exposed fish (referred to as "hanging bait" in the commercial fishery) was used. Pots were soaked for 2–4 d, but all pots in a block had approximately the same soak time. Upon retrieval, CL of all red king crabs and CW for Tanner crabs *Chionoecetes bairdi* were measured to the nearest millimeter. Sex, reproductive condition of females, and legal status for males were also recorded.

Size-frequency distributions of red king crabs captured in standard and experimental pots were compared by the Kolmogorov-Smirnov two-sample test. We defined CPUE as the number of crabs per pot haul, and it was not adjusted for soak time. We used the following three-factor analysis of variance (ANOVA) model to compare CPUEs of the 2 pot types by crab size and sex categories:

$$y_{ijkl} = m + a_i + b_j + g_k + (abg)_{ijk} + (ab)_{ij} + (bg)_{ik} + e_{ijkl}$$

where y_{ijkl} = CPUE for block *i*, pot type *j*, sex or size *k*, and pot *l*; m = overall mean CPUE; a_i = the effect due to block *i*; b_j = the effect due to pot type *j*; g_k = the effect due to crab group or size; e_{ijkl} = random error, and the remainders are two- and three-way interactions. We conducted our analysis in 2 ways: (1) by 3 crab categories — sublegal males, legal males, and females, and (2) by 9 size classes — <90, 90–99, 100–109, 110–119, 120–129, 130–139, 140–149, 150–159, and 160 mm CL. Cluster analysis was used to identify groups of experimental blocks with similar size composition and CPUE. We chose a = 0.05 as the statistical significance level.

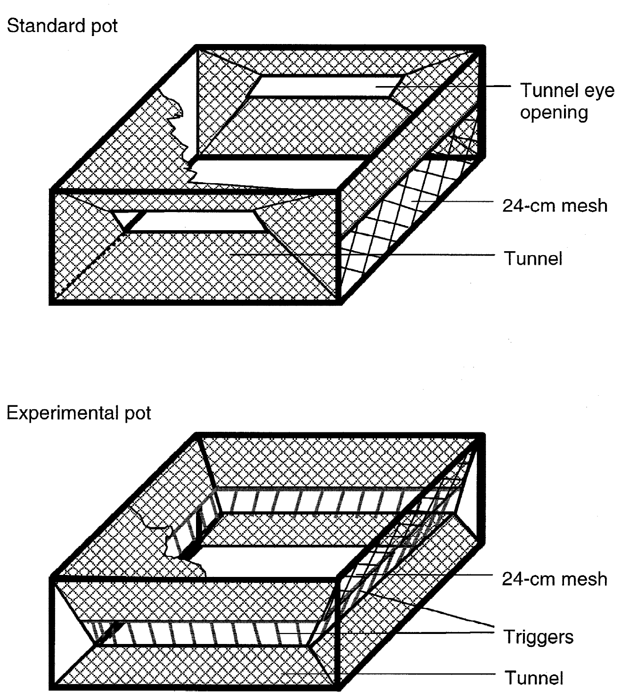

Figure 1. Design of the standard king crab and experimental pots. Dimensions of both pots were 213 × 213 × 86 cm.

RESULTS

CPUE between pot types

A total of 5,376 red king crabs, 109 Tanner crabs, 1 snow crab *Chionoecetes opilio*, and 1 male hybrid crab (Tanner and snow crab cross) were caught in the 91 pot lifts (45 standard pots and 46 experimental pots). Catch per pot (CPUE) for red king crabs ranged between 18 and 121 with a mean of 63.3 (SD = 26.0) for standard pots, and between 15 and 121 with a mean of 55.0 (SD = 28.1) for experimental pots (Table 2). Tanner crab CPUE was 0–9 with a mean of 1.7 (SD = 2.1) for standard pots and 0–11 with a mean of 2.3 (SD = 2.9) for experimental pots. Catch per pot for all crabs was 21–128 with a mean of 65.0 (SD = 26.6) for standard pots and 17–125 with a mean of 57.2 (SD = 28.1) for experimental pots.

An ANOVA conducted on all crabs revealed no interactions among block, pot type, crab group, or size ($P > 0.05$). When only red king crabs were considered and crab sex and size were combined, catch per pot was not significantly different between pot types ($P = 0.119$, statistical power = 0.423 for $d = 7.8$ crabs at $a = 0.05$, where d is the difference in mean CPUE between the 2 pot types), but it was significantly different among blocks ($P < 0.001$). When only red king crabs were considered and crabs were divided into 3 groups (legal males, sublegal males, and females), CPUE differed significantly among blocks ($P < 0.0001$), between pot types ($P = 0.032$), and among the 3 crab categories ($P < 0.0001$). Further analyses indicated no significant differences in CPUE between pot types for sublegal males ($P = 0.177$, statistical power = 0.313 for $d = 3.8$ crabs at $a = 0.10$) and for females ($P = 0.555$, power = 0.300 for $d = 0.3$ crabs at $a = 0.10$). Standard pots caught significantly ($P = 0.05$) more legal males, 25.3 per pot, than experimental pots, 20.5 per pot (Figure 3).

The CPUE for Tanner crabs also differed significantly among blocks ($P < 0.0001$), but not between pot types ($P = 0.182$, power = 0.378 for $d = 0.6$ crabs at $a = 0.10$). Because too few Tanner crabs were caught and retained in each pot, other comparisons were not possible for Tanner crabs. Hereafter, all results are for red king crabs unless specifically noted otherwise.

When effective pot volume was taken into account, the experimental pots were more efficient than the standard pots. We divided the CPUE by effective pot volume, 1.70 m^3 for the standard pot and 0.84 m^3 for the experimental pot, to obtain the catch per unit of effective pot volume (CPUV). The standard pot had CPUVs of 17.6, 14.9, and 4.7 for sublegal male, legal male, and female red king crabs, respectively. In contrast, the experimental pot had 32.0, 24.4, and 10.3 for the 3 crab groups, respectively. Experimental pots had significantly higher CPUV for all 3 crab groups ($P < 0.0001$). The CPUV ratios between the experimental pot and the standard pot were 1.8, 1.6, and 2.2 for sublegal male, legal male, and female red king crabs, respectively.

Size frequency distribution

Kolmogorov-Smirnov tests showed that size frequency distributions in all blocks combined differed significantly between the pot types ($P < 0.001$, Figure 4). Standard pots retained more crabs >125 mm CL. To further examine the effect of crab size on capture efficiency, a general linear model was used to analyze 9 10-mm CL size groups of crabs. Significant CPUE differences were revealed between the pot types in 3 categories: 130–139, 140–149, and 160 mm CL, where $P = 0.001$, 0.005, and 0.017, respectively. Conclusions cannot be made for other size groups due to low statistical power; P values varied from 0.995 to 0.063 and statistical power from 0.115 to 0.586 at $a = 0.10$.

Comparison within experimental blocks

Because CPUE and size composition varied among blocks, further comparisons were made within blocks. Cluster analysis on 6 blocks and 9 size classes of crabs indicated similar size compositions in blocks 1 and 6, and in blocks 4 and 5, and they were combined accordingly (Figure 5). Mean CPUE of different size

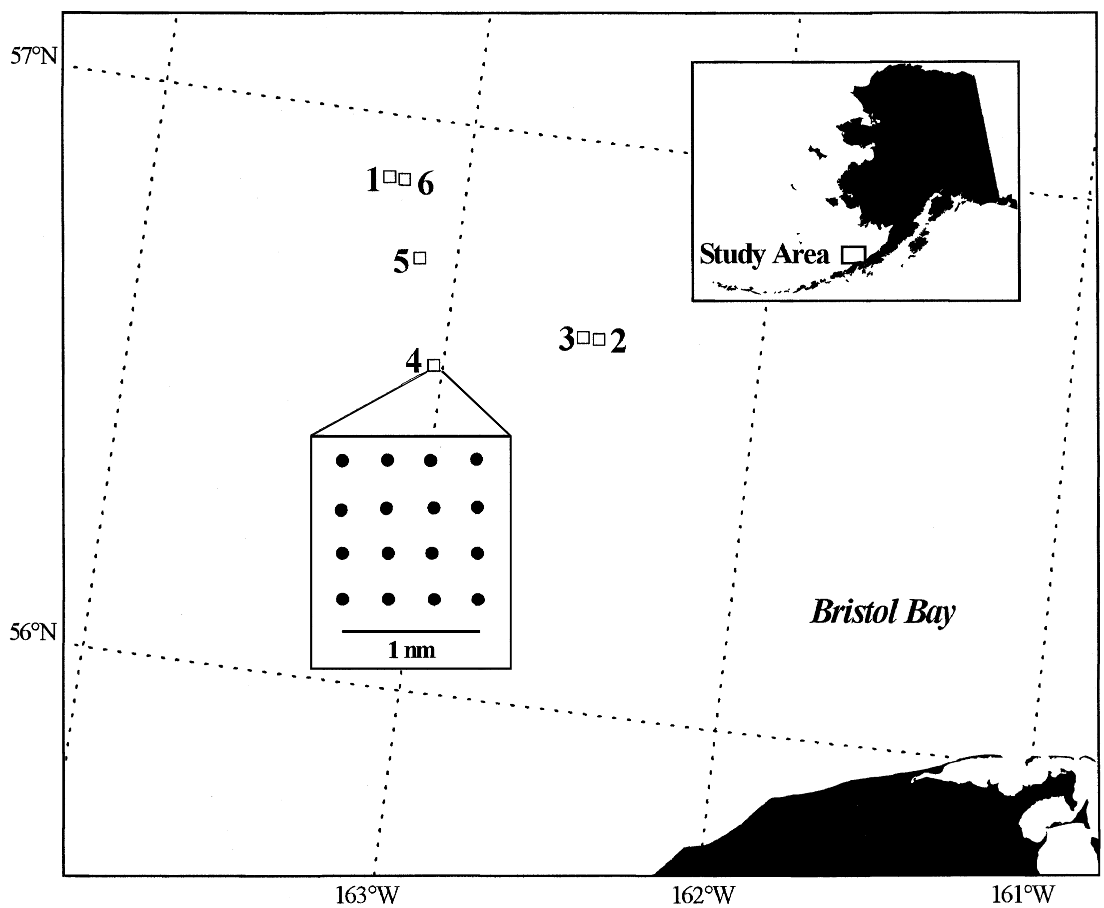

Figure 2. Locations of 6 experimental blocks in Bristol Bay in the eastern Bering Sea. Each block consisted of 8 standard and 8 experimental pots alternately deployed in a 4 × 4 grid.

Table 2. Mean CPUE (number of crabs per pot) for different crab groups in standard and experimental pots by experimental block.

	Standard Pot				Experimental Pot			
Block	Sublegal Male	Legal Male	Female	Tanner	Sublegal Male	Legal Male	Female	Tanner
1	31.0	26.3	9.7	0.0	31.6	26.6	11.6	0.8
2	47.1	23.5	17.3	3.1	47.6	18.0	20.7	4.1
3	42.4	24.4	17.7	2.6	36.3	24.3	16.4	2.1
4	12.4	25.3	0.7	2.7	10.4	16.6	0.5	3.9
5	18.5	21.0	1.4	1.3	13.6	16.3	1.0	2.8
6	28.3	31.3	1.5	0.4	21.8	21.3	1.9	0.1
Mean	30.0	25.3	8.0	1.7	26.2	20.5	8.3	2.3
SD	16.5	7.9	8.8	2.1	16.3	8.5	9.6	2.9
Total[a]	1,352	1,138	358	75	1,206	942	380	104

[a] Total number of crabs taken by all experimental or standard pots in all blocks.

classes varied within blocks. For any size class, standard pots caught more in some blocks and experimental pots caught more in others (Table 3). No significant differences in CPUE were found in block 3 or in the combined blocks 1 + 6, but significant differences existed in 4 large size classes in block 2 and in combined blocks 4 + 5 (Table 3). However, we note our use of multiple ANOVAs increased the probability of Type I errors.

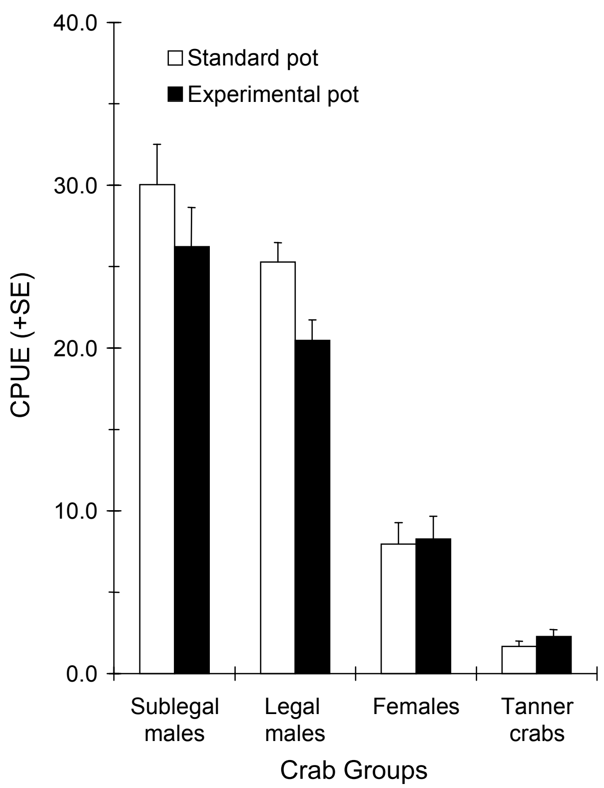

Figure 3. Comparison of CPUE (all blocks combined) between standard and experimental pots among Tanner crabs and 3 size/sex categories of red king crabs.

Effect of fishing location on crab size and CPUE

Differences in size composition and CPUE among blocks suggest an effect of fishing location. Most of the catch west of 163°W longitude was mature crabs >100 mm CL (blocks 1 and 6, and blocks 4 and 5; Figure 5). Higher CPUE was found in the north (blocks 1 and 6) than in the south (blocks 4 and 5). A large number of crabs <100 mm CL were captured toward the east (blocks 2 and 3). Most smaller crabs were probably immature as indicated by females without eggs. In this area, a shift in size composition occurred within a relatively short distance; more juveniles were found inshore (block 2) than offshore (block 3).

Effect of soak time

The effect of soak time on CPUE was examined in blocks 1 and 6 only. These blocks were close to one another and had similar size composition of crabs (Figure 5), but mean soak time in block 6 was twice as long as that in block 1 (Table 1). We did not compare other blocks because soak times were similar (Table 1), geographic separation was large, and because size composition and CPUE differed significantly (Figure 5). We conducted a two-way ANOVA on blocks 1 and 6 to examine CPUE of sublegal males, legal males, and females by pot type and soak time. No significant difference between the 2 pot designs was found among the 3 crab categories ($P \geq 0.170$; Figure 6). No effect of soak time was found, except that fewer females were captured in the 4-d soak than in the 2-d soak ($P < 0.001$). There was no significant interaction between pot type and soak time ($P \geq 0.143$).

Table 3. Comparison of mean CPUE between standard and experimental pots by crab carapace length (mm) interval. Blocks 1 and 6, and blocks 4 and 5 were grouped together because of similar size composition of crabs caught, CPUE, and geographic proximity. P = ANOVA probability value; * = $P \leq 0.05$, ** = $P \leq 0.01$.

		Carapace Length Interval (mm)								
Block	Pot	≤ 89	90–99	100–109	110–119	120–129	130–139	140–149	150–159	≥160
1+6	Standard	0.1	0.8	2.1	5.0	14.5	16.9	11.9	8.1	4.2
	Experimental	0.0	1.1	2.8	6.9	13.6	12.8	9.6	7.2	3.4
	P		0.437	0.236	0.104	0.634	0.077	0.134	0.525	0.833
2	Standard	17.3	15.5	6.4	6.0	10.8	11.3	11.1	6.6	3.0
	Experimental	18.4	20.3	7.0	5.3	10.7	10.1	7.6	4.4	1.7
	P	0.833	0.374	0.739	0.500	0.987	0.621	0.031 *	0.142	0.075
3	Standard	4.6	11.0	5.4	9.4	16.1	16.9	10.7	6.0	3.9
	Experimental	4.3	9.9	8.6	7.6	14.1	11.6	10.4	6.9	3.7
	P	0.853	0.761	0.196	0.285	0.520	0.198	0.910	0.510	0.920
4+5	Standard	0.0	0.2	0.4	2.5	6.9	9.1	9.2	6.6	4.7
	Experimental	0.1	0.2	0.7	2.4	5.3	5.2	6.9	4.4	3.0
	P				0.889	0.111	0.003 **	0.045 *	0.012 *	0.050 *

DISCUSSION

The experimental pot did not reduce the catch of non-legal crabs or increase the catch of legal crabs. Crab size compositions in the 2 pot types were similar, except standard pots retained a larger proportion of crabs >130 mm CL in some blocks than the experimental pots.

Several factors may have affected the overall performance of experimental pots in this field study. Because the experimental pot had a lower entrance opening, its effective capacity was half that of the standard pot. This capacity is reached when crabs fill the pot and block the triggers so additional crabs, especially large-sized ones, cannot readily enter. When the pot was lifted out of the water, we observed that crabs typically filled over half the pot's volume, which was approximately the pot's effective capacity. When the catch was standardized by effective pot volume, the experimental pots retained significantly more crabs than the standard pots.

The mean CPUE in our study was unusually high: 63.3 crabs for standard pots and 55.0 for experimental pots, and many pots caught >100 crabs. The mean CPUE in the commercial fisheries during 1990–1993 was 19.8–30.5 king crabs of all sizes and sexes (Beers 1992; Tracy 1994, 1995; Zhou and Shirley 1996). The red king crab fishery was closed in Bristol Bay in 1994 and 1995 prior to this study. Summer trawl surveys showed that male and female crab abundance increased during 1993–1996 (Stevens et al. 1996; Zheng et al. 1996). We set pots farther apart than would occur in the commercial fishery, and no pots from other fishing vessels competed with ours during the experiment; these factors may have contributed to our high CPUE. Moreover, our pots were placed in prime fishing locations that probably would become saturated with gear during a fishery, thus forcing fishers into areas with lower crab concentrations. Although the standard pot caught and retained more crabs at the unusually high catch rates encountered in our study, further studies are needed to determine if the experimental pot is more efficient at lower crab densities. The experimental pot outperformed the standard pot at low crab densities (0.8 crabs/m^2) in laboratory experiments (Zhou and Shirley 1997a).

The large-mesh panel used in standard pots may have reduced CPUE of small crabs relative to pre-1996 standard pot designs. The large-mesh panel was a recent regulation requirement and had never been used in the commercial fishery before our experiment. The position of large-mesh webbing also may have allowed more small crabs to escape from standard pots than experimental pots. The 240-mm webbing was positioned near the bottom of the side panel in standard pots, and close to the top of the side panel in experimental pots. The total body length (TL), measured from the tip of the rostrum to the posterior end of the body, and body height (BH), the greatest distance between ventral and dorsal surfaces, are critical dimensions affecting the ability of crabs to escape through an opening such as mesh webbing (Brown 1982; Zhou and Shirley 1997a). Zhou and Shirley (1997a) established relationships between TL and CW, and between

BH and CW for red king crabs. For males, TL = 0.80 CW + 40.4, BH = 0.53 CW; for females, TL = 1.05 CW + 20.8, BH = 0.88 CW - 25.9 (all measured in millimeters). The greatest circumference crossing the anterior and the posterior section is less than 2(TL + BH). The stretched mesh size of 240 mm (= 480 mm circumference) should allow male crabs ≤150 mm CW and female crabs ≤127 mm CW (i.e., both male and female crabs with greatest body circumference < 480 mm) to escape easily. Crabs *Cancer irroratus* and lobsters *Homarus americanus* are able to orient themselves to escape through the smallest opening they could be pushed through by hand (Stasko 1975). Although many spines cover their body surface, red king crabs escape surprisingly well. In an escape experiment with legal (≥ 178 mm CW) and sublegal red king

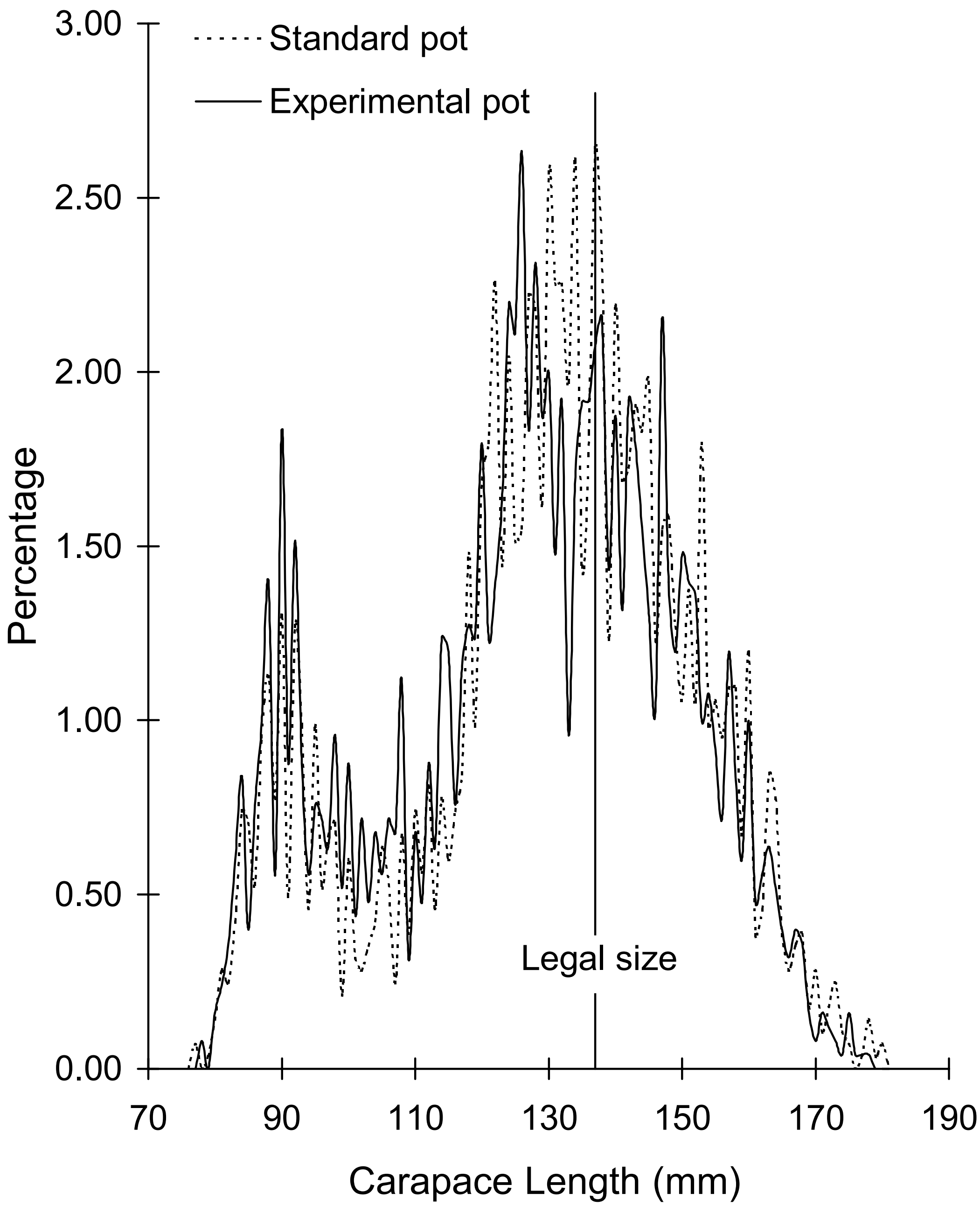

Figure 4. Size frequency distribution (all blocks combined) of red king crabs captured in standard versus experimental pots. Significant differences existed between the 2 pot types.

crabs (≤175 mm CW and ≤155 mm CL) in pots soaked overnight, 5% of legal crabs and 73% of sublegal crabs escaped through 166-mm mesh, 50% of legal crabs and all sublegal crabs escaped through 214-mm mesh, and all crabs escaped through 271-mm mesh (Marshall and Mundy 1985). It is difficult to imagine how a crab of 178 mm CW could exit through a 166-mm mesh, given that its TL + BH is approximately 277 mm and its circumference is approximately 554 mm. Zhou and Shirley (1997b) observed a juvenile red king crab of 90.1 mm CL and 95.5 mm in CW (TL + BH = 179 mm) exit through a 152.4-mm mesh. Thus, 240-mm mesh webbing should allow most sublegal-sized crabs to exit.

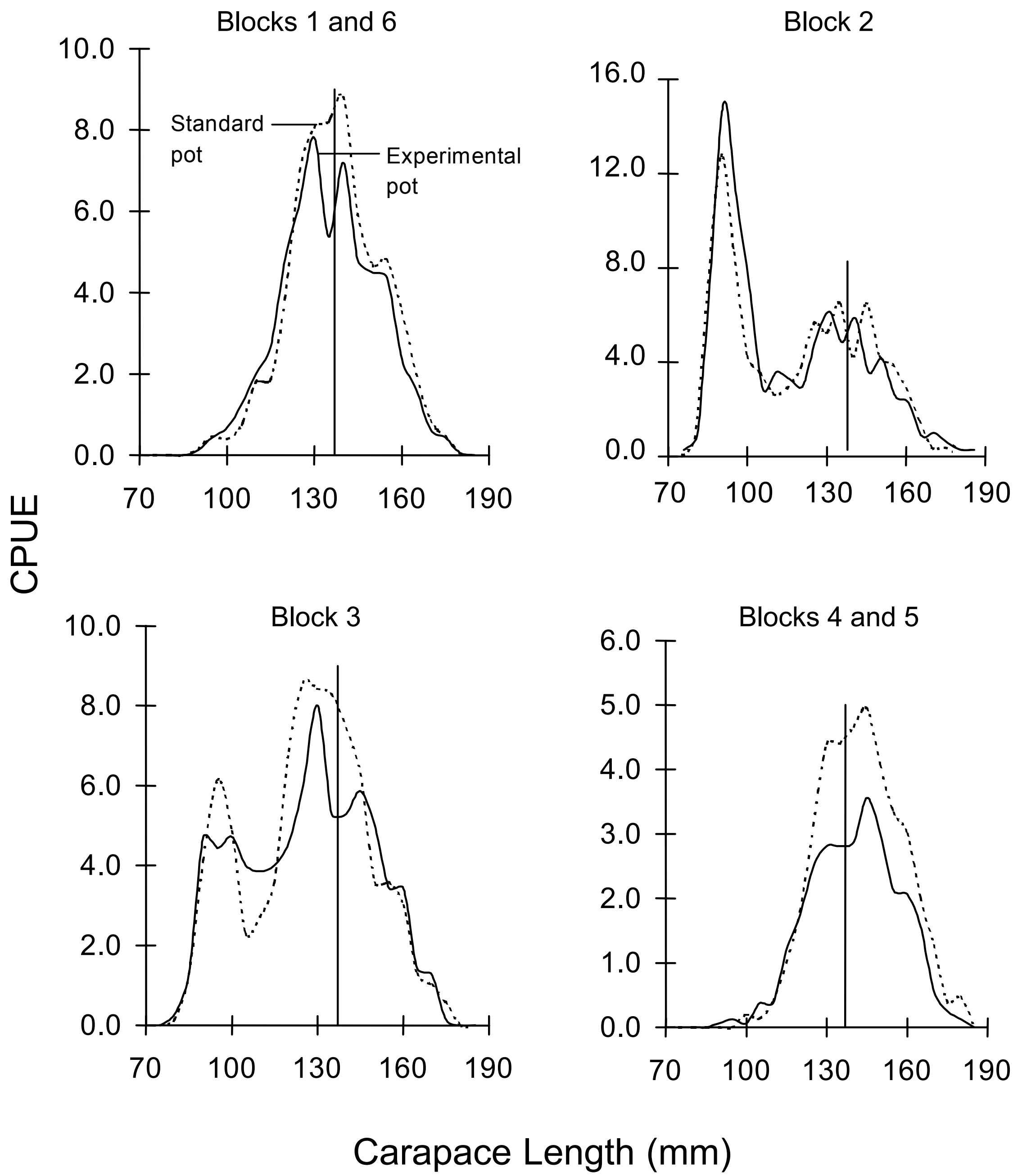

Figure 5. Red king crab CPUE for standard and experimental pots at different crab sizes. Blocks 1 and 6, and blocks 4 and 5 were combined because of similar CPUE, size composition, and geographic proximity. Significant differences existed between the pot types for size categories ≥ 130 mm CL in blocks 2, 4, and 5. The vertical line at 137 mm represents the size limit for retaining male crabs in the commercial fishery.

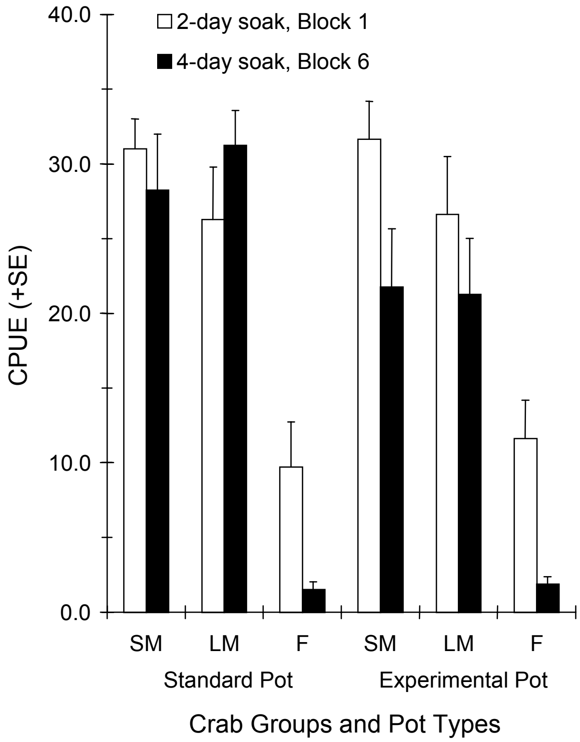

Figure 6. Comparison of CPUE between a 2-d soak and a 4-d soak for 3 groups of red king crabs caught in standard pots and experimental pots. A statistically significant difference was found for female crabs only. SM = sublegal males, LM = legal males, F = females.

Crab pots should be designed so that bait odor leads the crab to the pot entrance rather than just to the pot (Miller 1979). Crabs typically approach a baited pot from downstream (Miller 1980, 1990; Vienneau et al. 1993; Zhou and Shirley 1997b). Therefore, for pots with 2 side entrances, capture efficiency directly depends on orientation of the trap relative to the prevailing ocean current (Miller 1979, 1980; Zhou and Shirley, unpublished data). Our entrance design, which encircled the entire pot periphery, was intended to provide easy pot entry for crabs regardless of current direction. However, this advantage was suppressed by the factors we discussed.

One frequently asked question is whether a baited pot catches and retains many sublegal crabs during a 2-d soak if they can easily exit the pot. Our results suggest red king crabs could stay in baited pots for at least 2 d even though large mesh and entrance openings allowed small crabs to escape. We were surprised that many small crabs in blocks 2 and 3 were retained in pots. The high catch of small crabs might have been caused by: (1) crabs entering the pot shortly before the pots were lifted, (2) crabs remaining in the pot for a long time and not leaving even though they could, and (3) crabs repeatedly entering and exiting the pot. The first reason is least probable. The speed of the near-bottom tidal current is 1–5 $cm \cdot s^{-1}$ in the eastern Bering Sea (Coachman 1986), and the walking speed of red king crabs exceeded 5 $m \cdot min^{-1}$ in the laboratory tank when crabs were following the bait odor (S. Zhou, unpublished data). If we assume: (1) at the time a pot was set, crabs were near the neighboring pot or at most 617 m away, (2) the mean current speed was 2.5 $cm \cdot s^{-1}$, and (3) crab mean walking speed was 5 $m \cdot min^{-1}$, then crabs can approach the pot within 9 h of pot deployment. Therefore, most crabs within the area fished by one pot probably arrived at the pot long before it was lifted.

Results from several other studies shed light on the retention times of red king crabs by commercial pots. In a laboratory study, red king crabs stayed in pots for 0.08–35.52 h (mean = 3.2 h) even though they could easily exit through entrance openings (Zhou and Shirley 1997a). In a field study, Stevens et al. (1993) placed king crabs in unbaited, simulated “lost” pots and observed exit behavior using a remotely operated vehicle. In another field study, when king crabs were placed in pots without bait, all escaped through the webbing overnight if the mesh size was large enough (maximum 271-mm mesh; Marshall and Mundy 1985). In a third field experiment, 29.1% of sublegal red king crabs escaped from standard pots without bait in 1 d, 51.7% in 2 d, and 94.4% in 15 d (High and Worlund 1979). These 3 field studies differed from fishery situations because crabs were placed in pots and no bait was used. Unfortunately, studies have not examined how long crabs will stay in baited pots in a fishery when they can exit readily. A field study on entry and exit behavior of red king crabs over a range of pot soak times is required to resolve subtleties in pot modifications that reduce catches of female and sublegal male crabs while maintaining or increasing catch of legal-sized males under varying crab densities and tidal currents that occur during commercial fishing operations. Observations of crab behavior on the sea floor using a remotely operated vehicle are necessary so that the experimental pot can be redesigned to achieve its intended purpose under commercial fishing conditions. Soak times must be considered along with escape mechanisms to design effective management measures to reduce bycatch of sublegal male and female crabs.

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