

Daily effort, soak time, catch, and bycatch data collected by at-sea observers during the 1997 and 1998 Bristol Bay red king crab fishery seasons,
Report to the Alaska Board of Fisheries.

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INTRODUCTION

In August 1997 the Alaska Board of Fisheries (BOF) adopted new regulations, 5AAC 34.825 (h) (ADF&G 1998a), for the Bristol Bay red king crab *Paralithodes camtschaticus* fishery. These regulations established 6 tiers of pot limits for the fishery, with the pot limit for any one season being dependent on the pre-season guideline harvest level (GHL) and number participating of vessels. To conform to guidelines for pot limits frameworked in the federal management plan for the fishery (NPFMC 1989), each tier of pot limits restricts “small” vessels (vessels <125’ in length overall, LOA) to 80 percent of the number of pots allotted to “large” vessels (vessels \geq 125’ LOA). Notably, these regulations also established a minimum 4 million-pound GHL for prosecution of the Bristol Bay fishery and the use of pre-announced closures for seasons with GHLs less than 12 million pounds when more than 250 vessels enter the fishery.

The board’s action stemmed from a petition submitted by ADF&G shortly after the 1996 Bristol Bay season. In that season the harvest exceeded the GHL of 5 million pounds by nearly 70 percent during an unprecedented 4-day season (Morrison and Gish 1997). At the August 1997 BOF meeting the department attributed the harvest in excess of the 1996 GHL to high catch per unit effort (CPUE) and high fishing effort (number of pot lifts) relative to the low GHL (Tracy 1997). Under the pot limit regulations in effect for the 1996 season (defined in 5AAC 34.825 (d) (ADF&G 1993)) small and large vessels were allowed 200 and 250 pots, respectively. The department argued that the effort resulting from those pot limits was excessive relative to the 5 million pound GHL and expressed concern that inseason management of the red king crab stock at reduced GHLs was not possible under status quo regulations. Reduced pot limits were suggested as a means to improve inseason management at low GHLs.

The BOF attached a two year “sunset” clause to 5AAC 34.825 (h) with the intention of re-addressing Bristol Bay pot limits and management measures at the March 1999 statewide king and Tanner crab BOF meeting. The BOF noted that questions remained on the effectiveness of these new regulations and directed the department to gather needed information during the 1997 and 1998 seasons. Aside from the effectiveness of the new pot limit regulations in facilitating inseason management, the BOF also desired information on the effects that reduced pot limits may have on bycatch rates of undersized and female red king crabs.

Prior to the November 1997 and 1998 red king crab seasons ADF&G solicited volunteers from participating catcher-only vessel operators to carry department biologists as onboard observers. The purpose of those deployments was to collect data on effort, directed catch rates and bycatch rates. The department also requested that the operator of each observed catcher-only vessel document their fishing effort on a daily basis throughout the course of the season. Mandatory observers deployed on catcher-processor vessels also obtained data on catch rates and fishing locations during the 1997 and 1998 seasons. Although not presented in this report, department biologists deployed as observers on catcher-only vessels during the 1997 and 1998 seasons also collected data on the incidence of handling injuries to non-retained crabs and the air-exposure times of non-retained crabs prior to being returned the sea.

During the 1997 Bristol Bay red king crab season small vessels were limited to 100 pots and large vessels to 125 pots under the new regulations in 5AAC 34.825 (h). Pot limits for the 1998 season

were 200 and 250 pots per vessel for small and large vessels, respectively. The 1997 Bristol Bay fishery opened by regulation at 4:00 PM on November 1 and concluded at 6:00 PM on November 5 (Morrison 1999a). A total of 256 vessels registered 27,500 pots for the 1997 season and harvested nearly 8.8 million pounds of red king crabs, exceeding the 7-million pound GHLL by 25 percent. The approximately 1.3 million crabs harvested during 1997 was taken in a reported 90,510 pot pulls for a season CPUE of 15 crabs per pot. The 1998 season lasted exactly five days, closing at 4:00 PM on November 6 (Morrison 1999b). The 14.2 million pounds harvested during the 1998 season equaled 90 % of the 15.8 million pound GHLL. A total of 141,707 pot pulls were performed by the 274 vessels participating in the 1998 season and resulted in a CPUE of 15 crabs per pot.

The effects on effort and catch of the reduced pot limit during the 1997 season have been documented in a summary of the information provided by vessel operators during post-season interviews and inseason catch and effort reports (Tracy and Pengilly 1999). The information collected by onboard observers during the 1997 and 1998 seasons provides further insight into how pot limits can affect fishing practices and into the effectiveness of pot limits and associated regulatory measures in meeting management objectives.

METHODS

Observed Vessels

ADF&G biologists were deployed with the voluntary consent of vessel operators on a total of 21 catcher-only vessels; 11 in the 1997 fishery and 10 in 1998. Four of the 21 deployments represent two vessels observed during consecutive seasons. The names of the observed catcher-only vessels have been omitted from this report due to the proprietary nature of the catch and effort data.

In order to acquire an adequate sample of vessels fishing different complements of gear as allowed by pot limit regulations, overall size was the principal vessel selection criteria for observer deployments during both years. Accordingly, the sample of observed vessels consisted of 10 vessels <125' LOA and 11 vessels \geq 125'LOA. Five vessels carried 100 pots during the 1997 season and the remaining six were allowed 125 pots. In 1998, five vessels fished 200 pots and five fished 250 pots.

In addition to the voluntarily observed catcher-only vessels, mandatory observers were deployed by regulation on eight catcher-processors participating in the 1997 fishery and on 11 catcher-processors in 1998 (Boyle et al. 1998, 1999). Each of these vessels exceeded 125' LOA and thus all carried the maximum 125 pots and 250 pots, respectively, during the 1997 and 1998 seasons.

Fishing Logs

Daily catch and effort statistics from all of the catcher-only vessels carrying observers were directly provided by the individual operators. In 1997, seven vessel captains agreed to record on a

“Pilothouse Log” the date, time, depth, location, and catch of legal-sized crabs from each pot set and retrieved over the course of the fishery. The remaining four operators declined to provide the department with as detailed an account of their fishing activities, and instead recorded a daily summary of their effort and catch by string for each statistical area fished. During the 1998 season all 10 operators of the catcher-only vessels observed documented their fishing activities using the pilothouse logs.

Pot-Catch Sampling

Observers on both catcher-only vessels and catcher-processors randomly sampled pot catches on a daily basis during the season. Sampling goals on catcher-only vessels equaled 12 pots for each day of fishing activity in 1997 and eight pots per day in 1998. At least four pots per fishing day were sampled by observers deployed on catcher-processors during both seasons. Pot sampling methods consisted of identifying and enumerating the catch, recording the size and shell condition of all commercially important crabs, assessing the reproductive status of female crabs, and noting irregularities (such as injured or parasitized animals). A comprehensive description of pot catch sampling methods is available in the “ADF&G Shellfish Observer Field Manual” (ADF&G 1998b).

Estimates and standard errors of the legal catch and bycatch per pot for observed vessels were generated from the pot-catch sample data using weighted variance formulas for stratified sampling (Cochran 1977). With this technique each vessel-day is considered a separate stratum. The weights reflect the relative importance of a vessel’s daily sampling compared to all days on which sampling occurred. The more pots sampled on a given day, the greater the weight for that day. Variances were calculated for each vessel-day and then summed over all vessels and all days for the entire fishery.

RESULTS

Fishing Effort

Pots Set and Pulled

Fishing statistics compiled from Pilothouse Logs and daily catch and effort summaries from the observed catcher-only vessels (Table 1, Figures 1, 2, 3) revealed differences in pot setting and retrieval activity among individual vessels during both years. A feature common to all observed catcher-only vessels in both years, however, was that pots were set, but not pulled, on November 1 (Table 1). Figure 1 depicts the pot setting and retrieval chronology for six vessels observed in 1997¹ and indicates that the crews of each vessel set all their pots within eight hours of the 4:00 PM fishery opening. With the increase in pot limits, crews set more pots during the opening eight hours of the 1998 season than did their counterparts from the same vessel size class during the 1997 season (Figures 2 and 3). Only the crew of one vessel during 1998 (vessel U; Figure

¹ Only six of the 11 catcher-only vessels observed maintained catch and effort records sufficient to chronicle all pots set and pulled during the season.

3), however, appeared capable of nearly setting its limit of pots prior to November 2. The gain in pots set during the early hours of the 1998 season relative to the 1997 was most pronounced for the large vessel class. The 110 pots set by the average small vessel on November 1 1998 was only 10 pots greater than the 1997 small vessel pot limit, whereas the average of 181 pots set by large vessels on that day was 56 pots greater than the 1997 large vessel pot limit.

Of the 21 catcher-only vessels observed in 1997 and 1998, all but one (vessel F) began to pull fished pots on November 2. During the 1997 season eight of the total 11 vessel crews pulled more than 90 pots on that day and at least three (from vessels A, B, and D) retrieved and then reset their limit of 100 or 125 pots (Table 1). In 1998 the crews of all 10 observed vessels began retrieving fished gear on November 2 (Table 1). Unlike 1997, however, some vessels (L, O, P, R and S) apparently began pulling pots before they had set all their pots (Figures 2 and 3). In the 1998 fishery the small vessels pulled only 29 pots on average during November 2 as compared to an average of 98 pot pulls for large vessels on the same date (Table 2). No such disparity existed in the November 2 pot pulls during the 1997 fishery; in fact, the observed small vessels pulled more pots than the large vessels on November 2 of that year (Table 2). Comparison of the temporal pattern of setting and pulling pots for small vessels (Figure 2) and large vessels (Figure 3) on November 2 1998, suggests that small vessels generally began pulling their gear later than large vessels (notable examples here are vessels M and N). The delay in pulling pots on November 2 1998 exhibited by the small vessels such as M and N (Figure 2) apparently reflects the time required for first retrieving and then setting additional stored pots.

In both 1997 and 1998 daily effort increased after November 2. During November 3-4 of the 1997 season at least four of the six crews (from vessels A, B, C and D) retrieved and re-set all their gear at least once every 24 h, averaging more than 100 pot pulls per day (Table 2, Figure 1). Unlike 1997, in 1998 no observed vessel appeared capable of retrieving and re-setting its limit of pots on a daily basis. In fact, the small vessels showed little gain in 1998 over 1997 in the daily pot sets and pulls. Large vessels did show a notable increase in pot sets and pot pulls in 1998 as compared to 1997. As a result, the observed large vessels consistently set and retrieved more pots on a daily basis than did small vessels during 1998, with the overall fishing effort of the larger boats exceeding that of small vessels by 50% (Table 2).

In 1997, a 20-h advance closure notice of the Bristol Bay season was issued by the department (Morrison 1999a). During this period 10 of the 11 observed vessels were able to retrieve or unbait all their fished pots (vessel A left 9 of 100 baited pots on the grounds). Additionally, at least five of the 10 vessels (vessels A, B, C, E and G) were also able to set and pull an average of 27 additional pots (Table 3). Notice of the 1998 season closure was issued 44 h in advance to accommodate the increased pot limit (Morrison 1999b). As Table 3 shows, the crews of all 10 observed vessels continued to set pots during this period, and in fact managed to re-deploy an average of 35% of their allowed gear. Each vessel crew was also able to retrieve or unbait all their pots within the closure notice period and one crew (from vessel Q) pulled nearly 400 pots during this time interval.

Soak Time

Daily pot soak times calculated from pilothouse logs varied between the two seasons. During the 1997 fishery the crews of vessels providing this information soaked their pots an average of less than 24 h on three of four total fishing days; in 1998 mean daily soak times equaled at least 33 h on five

of six days, and exceeded 36 h on two days (Table 4). Accordingly, overall mean soak times differed by nearly 10 h (equaling 22.5 h in 1997 and 32 h in 1998).

The mean pot soak hours per fishing day also differed both between and within large and small vessel size classes during the two seasons. On each day of the 1997 fishery the crews of large vessels soaked their gear an average of at least 24 h (Table 4). In the same season mean pot soak times for small vessels were less than 20 h on every day except November 3. During the 1998 season this trend was reversed although the soak times used by small and large vessels were more comparable to each other than in 1997. During 1998 the crews of small vessels soaked pots an average of 35 h or more on four of five fishing days, whereas those of larger vessels maintained average daily soak times of 35 h or less.

Fishing Performance

CPUE of Legal Crabs

Daily average CPUE during 1997 and 1998 of legally retained crabs for the catcher-only vessels that carried ADF&G biologists are displayed in Table 5. Overall mean vessel CPUE ranged from 8.8 crabs to 26.8 crabs in 1997, and from 8.3 crabs to 29.3 crabs in 1998. Trends in CPUE by day for the observed catcher-only vessels during 1997 and 1998 were comparable to that seen for the entire fleet (Tracy and Pengilly 1999). The average catch was highest on the last day of the fishery in 1997. By contrast, in 1998 the highest average catches were recorded on the 3rd day (Nov 3) of the fishery, and steadily decreased over the remaining three days.

Data from pilothouse logs shows that CPUE during 1997 and 1998 was highly variable among vessels, from day to day, and within days during the 1997 and 1998 seasons. Figures 4 and 5 show the high variability in fishing performance that existed over the course of the 1997 and 1998 seasons. For 1997, only vessel C had a fairly constant, low catch rate throughout the fishery, with slightly elevated catches on the last day (Fig 4). Other vessels during 1997, most notably vessel D, showed wide variation (from less than 10 to more than 100 crabs per pot) and low predictability in number of legal crabs per pot both from day to day and within days. Somewhat less variability was seen in the CPUE of the observed catcher-only vessels during 1998 (Figure 5). Nonetheless, variability in temporal trends of CPUE were apparent during the 1998 season. The performance of vessel P in 1998, for example, was characterized by constant catches that only occasionally exceeded 20 crabs. On the other hand, vessel U in that same year showed a steady decline from catches of more than 80 legal crabs per pot on November 2 to less than 20 legal crabs per pot on November 6 (Fig. 5).

Soak Time and CPUE of Legal Crabs

During the 1997 season median catch of legal crabs as indicated in Pilothouse Logs showed little variation over the range of 0 h to 30 h in both small and large vessel samples (Figure 6). For data from large vessels in 1997 some increase in median catch per pot was seen with increases in soak time to the range of 30 h to 50 h. For the 1998, fishery median catch was relatively flat with increasing soak time for small vessels but showed a positive trend with soak time for large vessels. In the case of either year or vessel size class, however, Figure 6 shows that soak time

alone is a very poor predictor of legal catch during the fishery; extremely wide variation in legal catch exists in each of the soak time categories.

Distribution of Effort and CPUE of Legal Crabs

The location of sampled pots and the relative size of catches of legal retained crabs in those pots are shown in Figure 7. Pots were sampled in 9 statistical areas in 1997 and in 10 statistical areas in 1998. The majority of pots sampled in both 1997 and 1998 were located in statistical area 625630. The largest catches in sampled pots also came from this statistical area (maximum=99 in 1997, 98 in 1998). In general, the distribution of effort on all observed vessels occurred within the waters traditionally targeted during this fishery (Morrison 1999a, 1999b). Some broad trends in geographic variation of CPUE are apparent, such as the tendency towards highest CPUEs in statistical area 625630 and the lower CPUE for sampled pots east of 162° during the 1998 fishery. However, Figure 7 also shows that catches can vary substantially within a more localized geographic scale.

Bycatch

Composition and Catch Per Pot

ADF&G biologists and contract observers randomly sampled the contents of 600 pots during the 1997 fishery season and 399 pots during the 1998 season. Table 6 displays CPUE estimates for legal, sublegal male, and female red king crabs for the 1997 and 1998 seasons. It should be noted that legal crab CPUE from the 1997 pot samples was biased low as an estimate of the CPUE for observed catcher-only vessels (16 crabs per pot; Table 5) and as an estimate of the fleet-wide CPUE (15 crabs per pot; Morrison 1999a). The legal crab CPUE in pots sampled by observers during 1998, on the other hand, were reflective of the fleet-wide CPUE of 15 crabs per pot (Morrison 1999b). Despite those differences in accuracy that the pot sampling from the 1997 and 1998 seasons provided in estimating CPUE of legal crabs, the difference between the 1997 and 1998 seasons in the bycatch rates seen in those samples are too large to be attributed to sampling error or bias.

Bycatch rates of female and undersized male red king crabs in sampled pots during the 1997 season were relatively low, accounting for 47% (5,631 of 12,031) of the sampled red king crabs. Females in particular were rarely encountered in pot samples during that season; sampled pots contained approximately 12 times as many male red king crabs as females (11,091 males vs. 939 females). Legal males comprised 58% (6,400 of 11,092) of the sampled red king crab males. The length frequencies for sampled male crabs shows a pronounced mode for males centered at about 150 mm and a smaller mode centered at about 105 mm (Figure 8). Sampled females exhibited a single mode centered at about 118 mm.

Pot sample data indicates that bycatch of non-retained red king crabs was much higher during the 1998 season than during the 1997 season. During the 1998 season incidence of females in sampled pots increased substantially; roughly one-third (9,311 of 27,051) of the red king crabs in sampled pots were female. Legal males comprised only 35% (6,186 of 17,740) of all male red king crabs sampled and only 23% (6,186 of 27,051) of all red king crabs sampled. Length

frequencies for the 1998 sampled male crabs display one mode at about 125 mm; females display a mode centered at approximately 105 mm (Figure 8).

A complete enumeration of all animals observed in sampled pots during the 1997 and 1998 seasons can be found in observer database reports for those years (Moore et al. 1998, 1999).

Soak Time and Bycatch

In the sampled pots from both 1997 and 1998, bycatch of sublegal male red king crabs per pot (Figure 9) and of red king crab females per pot (Figure 10) showed no consistent dependency upon soak time.

Distribution of Effort and Bycatch

Bycatch of females showed a very strong dependence upon the location of sampled pots (Figure 11). In the 1997 fishing season, two groups of pots containing large catches of females were located around 56 N latitude, 163 W longitude and 57 N latitude, 163 W longitude. In 1998 female crabs were encountered in all statistical areas where pots were sampled. However, bycatch of females was highest on the western edge of the sampled-pot distribution and the largest catches of females occurred in statistical area 615630 where every sampled pot contained females.

Bycatch in sampled pots of sublegal red king crab males did not show geographic trends or variation as striking as was seen in the bycatch of females. One trend that was apparent during the 1997 season, however, was that the greatest number of sublegal males in sampled pots occurred in the northeastern corner of statistical area 625630.

DISCUSSION

Data on the 1996, 1997, and 1998 Bristol Bay red king crab seasons provided by vessel operators during inseason catch reports and post-season interviews indicated that changes in effort and soak time occurred with changes in pot limits (Tracy and Pengilly 1999). Data collected by ADF&G staff observers on catcher-only vessels during the 1997 and 1998 Bristol Bay red king crab seasons help explain some of those trends in effort and soak time between seasons, particularly with regard to differences that were associated with vessel size class. The ADF&G deployments on catcher vessels coupled with the deployment of mandatory observers on catcher-processors also provided important information on the effects of pot limits that would otherwise be unobtainable.

The trend of increased pot pulls and soak times in 1998 relative to 1997 indicates that those changes were the result of the higher pot limits in 1998 (200 and 250 pots for small and large vessels, respectively, in 1998, as opposed to 100 and 125 for small and large vessels, respectively, in 1997). The tendency for large vessels to set more pots than small vessels during the opening hours of the 1998 season leads to the conclusion that such activity was the result of an increased availability of pots for the larger vessels to carry onboard at the onset of the fishery. Evidence that crews of large vessels consistently set and pulled more pots on a daily basis in

1998 than did their counterparts on small vessels suggests that large vessels were better able to take advantage of the higher pot limits than were small vessels. On the other hand, under the lower pot limits of 1997, the observed small and large vessels were roughly equal in their abilities to set and pull gear.

When closing fishing seasons, managers strive to provide adequate advance notice in order to allow vessel crews to comply with regulations requiring removal of all fished gear from the water by the effective closure date and time. Current Bristol Bay red king crab regulations allow baited pots to be left on the fishing grounds if a closure announcement is issued less than 24-h prior to its implementation (5AAC 34.827 (c); ADF&G 1998a). During the 1997 season the closure announcement was issued only 20 h prior to the closure. That period was apparently sufficient for the 10 observed catcher-only vessels to remove or unbait their gear. Only one of the 10 vessels left any pots (6) in fishing condition in 1997, but at least four vessels (including the one that left gear on the grounds) continued to set pots after the closure announcement was made. Fishery managers have provided the fleet with a 48-h closure announcement when higher pot limits are in effect. In 1998 a 44-h closure announcement was provided to the fleet. That period was sufficient for all of the 10 observed catcher-only vessels to set more pots and to remove or unbait all their pots.

Like the fleet at large (Tracy and Pengilly 1999), the observed catcher-only vessels showed an increase in the soak times used in 1998 relative to 1997. Experimental studies (e.g., Pengilly and Tracy *in press*) have shown that catch of legal red king crabs will increase with soak times from 12h to 72 h. The increase in soak time that occurred in 1998, however, was not associated with any substantial increase in CPUE of legal crabs. Within seasons, there was an indication of increasing CPUE of legal crabs with increases of soak time up to at least 50 h. However, CPUE was highly variable at any soak time and soak time alone was a poor predictor of CPUE. CPUE of legal crabs from sequentially pulled pots for individual vessels showed that CPUE for a single vessel could change by one or two orders of magnitude between days and within days, indicating that localized temporal and, especially, spatial effects were more important in determining CPUE than was soak time. In general, the data presented here provide no indication that the reductions in soak times used with a 100/125 pot limit relative to a 200/250 pot limit substantially reduce CPUE of legal crabs. That is, it appears that any gain in manageability that the lower pot limits in 1997 may have afforded were due mainly to the decrease in daily pot pulls and less to the decrease in soak time.

Soak time was an especially poor predictor of bycatch both within season and between seasons; bycatch of sublegal males and females was substantially higher in 1998 than in 1997 and no association in bycatch and soak time was detectable within seasons. The increase in bycatch during 1998 is coincident with the recruitment of a large cohort into mature size classes for females and sublegal males (Zheng et al. 1998). The high bycatch in 1998 is probably accounted for by that recruitment event coupled with a tendency for females and sublegal males to assume a more western distribution into the fishing grounds with increasing size. An experimental study of soak-time effects on bycatch of red king crabs showed that, whereas soak time can be a significant factor, local effects are also important in determining bycatch rates (Pengilly and Tracy, *in press*). Data on the location and contents of pots sampled by observers deployed on catcher-only vessels and catcher-processors during 1997 and 1998 revealed that bycatch varied on a broad geographic scale, indicating that location of a fished pot was the most important factor in determining bycatch rates within a season.

What may be most impressive in the detailed data collected during the deployments of ADF&G biologists on catcher vessels is the view that they provide on the wide range of practices employed by vessel operators and the variability in performance that vessels operators experience. Data summaries providing estimates of mean effort by vessels or mean CPUE for a fishery season (e.g., Tracy and Pengilly 1999) do not account for such diversity in the fleet. For example, whereas the average vessel in 1997 pulled more than 70% of its pot limit on November 2 (Tracy and Pengilly 1999), the data presented here also shows that at least one vessel let all its pots soak without pulling a single pot on that day. Although management agencies must make decisions or predictions based on mean behavior or performance, there should also be the appreciation for such variation that exists about the mean. Knowledge that such diversity in fishing practices and performance exists also helps to clarify the seemingly contradictory testimonies that can be given by vessel operators during public meetings on fishery issues. Most directly applicable to questions on manageability of the Bristol Bay red king crab fishery, these data show the unpredictable and enormous changes that can occur in vessels' CPUE. Such unpredictable changes in CPUE can, when averaged over an entire fleet, result in harvests below the GHL or, as occurred in 1997, in excess of the GHL.

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Table 1. Number of pots set and pulled daily by observed catcher-only vessels during the 1997 and 1998 Bristol Bay red king crab fishery season.

		Year/Vessel																				
		1997 ^a											1998 ^b									
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
Date	Activity																					
1 Nov	Set	91	100	125	124	122	125	125	-	-	-	-	103	111	113	115	108	181	142	180	164	236
	Pulled	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Nov	Set	98	100	50	126	36	0	60	-	-	-	-	63	78	89	50	102	129	117	72	161	161
	Pulled	91	100	84	124	60	0	95	125	98	100	120	11	30	18	68	20	66	89	103	75	158
3 Nov	Set	69	99	164	99	88	95	139	-	-	-	-	114	86	59	134	122	136	139	123	175	133
	Pulled	98	117	141	112	61	125	125	164	96	50	36	96	132	95	72	90	129	88	149	175	175
4 Nov	Set	121	130	111	121	84	78	88	-	-	-	-	142	125	121	126	102	141	180	187	134	148
	Pulled	104	113	130	139	84	48	104	177	118	54	73	146	88	89	129	127	161	121	123	133	139
5 Nov	Set	28	20	50	0	0	0	33	-	-	-	-	51	28	13	29	28	159	23	66	41	87
	Pulled	108	119	145	95	125	125	121	117	95	100	86	121	122	115	81	96	212	188	129	192	206
6 Nov	Set	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0
	Pulled	-	-	-	-	-	-	-	-	-	-	-	99	56	78	104	129	178	84	124	100	87
	Set	407	449	500	500	330	298	445	-	-	-	-	473	428	395	454	462	746	601	628	675	765
	Pulled	401 ^c	449	500	500	330	298	445	583	407	304	315	473	428	395	448 ^c	462	746	570 ^d	627 ^e	669 ^c	765

^a Data for vessels A-G from pilothouse logs; data for vessels H-K from and string summaries

^b Data from pilothouse logs

^c 6 pots lost and left on grounds

^d 601 total pots pulled; 31 pots retrieved with no dates recorded in pilothouse log

^e 1 pot lost and left on grounds

Table 2. Average number of pots set and pulled daily by observed catcher-only vessels during the 1997 and 1998 Bristol Bay red king crab fishery seasons.

Vessel	1 Nov		2 Nov		3 Nov		4 Nov		5 Nov		6 Nov		Total	
	set	pulled	set	pulled	set	pulled	set	pulled	set	pulled	set	pulled	set	pulled
1997														
<125' ^a	96	0	99	96	84	108	126	109	24	114	-	-	428	425
≥125' ^b	124	0	54	73	117	113	96	101	17	122	-	-	409	409
All	116	0	68	77	102	109	108	103	16	120	-	-	414	413
1998														
<125' ^c	110	0	76	29	103	97	123	116	30	107	0	93	442	442
≥125' ^d	181	0	128	98	141	143	158	135	75	185	0	115	683	677
All	145	0	102	64	122	120	141	126	53	146	0	104	563	560

^a 100 pot limit; 2 vessels in sample

^b 125 pot limit; 5 vessels in sample

^c 200 pot limit; 5 vessels in sample

^d 250 pot limit; 5 vessels in sample

Table 3. Pots set and pulled by observed catcher-only vessels following closure announcements for the 1997 a and 1998 b Bristol Bay red king crab fishery seasons.

Vessel	Pot Complement	Pots Set	Pots Pulled
1997 (n=7 vessels)			
A	100	35	137
B	100	50	150
C	125	46	119
D	125	0	110
E	125	26	126
F	125	0	125
G	125	33	121
Average for:			
<125'	100	43	144
≥125'	125	21	120
Overall	-	27	127
1998 (n=10 vessels)			
L	200	71	250
M	200	50	178
N	200	42	193
O	175	104	212
P	200	28	252
Q	250	192	390
R	250	70	288
S	250	75	262
T	250	83	325
U	250	87	314
Average for:			
<125'	195	59	217
≥125'	250	101	316
Overall	-	80	266

^a 20 hour notice; season closure announcement released at 2200 hours on 4 November 1997; season closed at 1800 hours on 5 November 1997.

^b 44 hour notice; season closure announcement released at 2000 hours on 4 November 1998; season closed at 1600 hours on 6 November 1998.

Table 4. Mean soak hours by fishing day from observed catcher-only vessels during the 1997 and 1998 Bristol Bay red king crab fishery seasons.

Day Fished	Mean Soak Hours					
	$\geq 125'$ ^a		$< 125'$ ^b		All Vessels	
	'97	'98	'97	'98	'97	'98
1 Nov	-	-	-	-	-	-
2 Nov	24	21	19	24	20	22
3 Nov	32	35	22	36	27	36
4 Nov	25	35	20	37	22	36
5 Nov	24	32	17	35	21	33
6 Nov	-	30	-	38	-	33

^a Vessels with a registered overall length $\geq 125'$: 5 vessels in 1997 and 5 vessels in 1998.

^b Vessels with a registered overall length $< 125'$: 5 vessels in 1997 and 5 vessels in 1998.

Table 5. Catch per unit effort (CPUE) of legally retained crabs from observed catcher-only vessels during the 1997 and 1998 Bristol Bay red king crab fishery season. Data are from pilot house logs.

Vessel	Number of Pots Fished	Date					Overall
		2 Nov	3 Nov	4 Nov	5 Nov	6 Nov	
1997							
A	100	16.7	14.4	13.9	6.8		13.0
B	100	5.6	12.9	4.2	21.0		10.9
C	125	9.6	8.9	6.6	10.2		8.8
D	125	9.7	15.9	41.9	39.8		26.8
E	125	20.3	30.8	22.0	18.6		22.9
F	125	N/A	17.9	6.3	25.6		16.6
G	125	14.8	5.6	6.7	31.5		14.6
Average for:							
<125'	100	11.2	13.7	9.0	13.9		11.9
≥125'	125	13.6	15.8	16.7	25.1		18.0
Overall	--	12.8	15.2	14.5	21.9		16.2
1998							
L	200	28.2	26.3	25.1	24.0	15.2	23.1
M	200	25.7	15.6	15.3	7.0	8.0	12.8
N	200	24.6	13.5	17.3	12.3	8.6	13.7
O	175	24.0	41.3	16.4	7.0	2.3	16.7
P	200	8.0	11.0	5.9	7.8	9.3	8.3
Q	250	20.4	17.9	18.2	12.1	5.7	13.6
R	250	16.0	20.8	26.5	15.2	16.6	18.2
S	250	1.8	20.0	9.0	5.9	12.0	10.4
T	250	29.1	41.6	30.6	26.0	12.2	29.3
U	250	42.1	37.8	27.3	18.3	3.0	27.8
Average for							
<125'	195	22.1	21.5	16.0	11.6	8.7	14.9
≥125'	250	21.9	27.6	22.3	15.5	9.9	19.9
Overall	—	22.0	24.6	19.2	13.6	9.3	17.4

Table 6. Estimated catch per pot (CPUE) of red king crabs from potlifts sampled by ADF&G biologists and contract observers during the 1997 and 1998 Bristol Bay red king crab fishery seasons. Standard errors of the CPUE estimates are included in parentheses.

Species / Sex Class	Total Pot Sample Catch	Estimated CPUE For Sampled Fleet	Estimated Total Fishery Catch ^a
1997			
Data from ADF&G Biologists (n=498 potlifts)			
legal males	5,455	12.25 (0.59)	1,109,000 ^b
sublegal males	3,721	9.38 (0.99)	850,000
females	854	1.61 (0.36)	146,000
Data from Contract Observers (n=102 potlifts)			
legal males	945	9.73 (1.10)	880,000 ^b
sublegal males	971	10.04 (2.18)	910,000
females	85	0.83 ^c	75,000
1998			
Data from ADF&G Biologists (n=254 potlifts)			
legal males	3,774	15.56 (0.65)	2,204,000 ^b
sublegal males	8,412	34.50 (2.24)	4,889,000
females	5,220	20.97 (1.87)	2,972,000
Data from Contract Observers (n=145 potlifts)			
legal males	2,412	15.96 (0.84)	2,262,000 ^b
sublegal males	3,142	21.22 (0.86)	3,007,000
females	4,091	27.40 (4.36)	3,883,000

^a Estimated CPUE multiplied by 90,510 total potlifts for 1997 fishery data and 141,707 total pot lifts for 1998 fishery data.

^b Actual catch of retained legal crabs from fish tickets was 1,315,969 in the 1997 fishery and 2,140,607 in the 1998 fishery.

^c CPUE computed as total pot sample catch divided by the total number of pots sampled; standard errors of estimates were not computed.

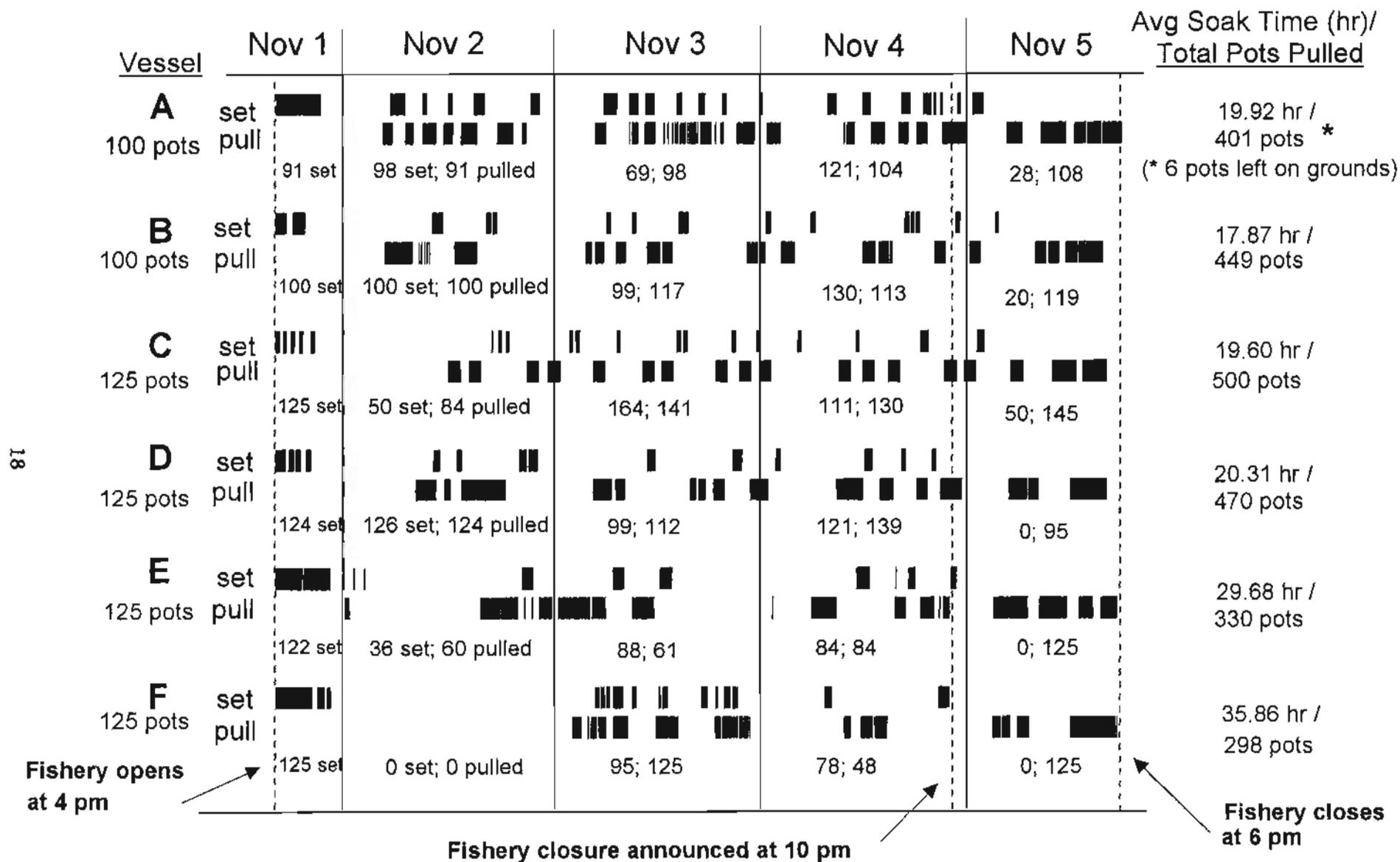


Figure 1. Frequency and number of pots set and pulled per vessel-day, average soak times and total pots pulled for 6 vessels (2 < 125' and 4 ≥ 125') on which ADF&G biologists were deployed in the 1997 Bristol Bay red king crab fishery. Each hash mark (|) represents the time at which a pot was set or pulled.

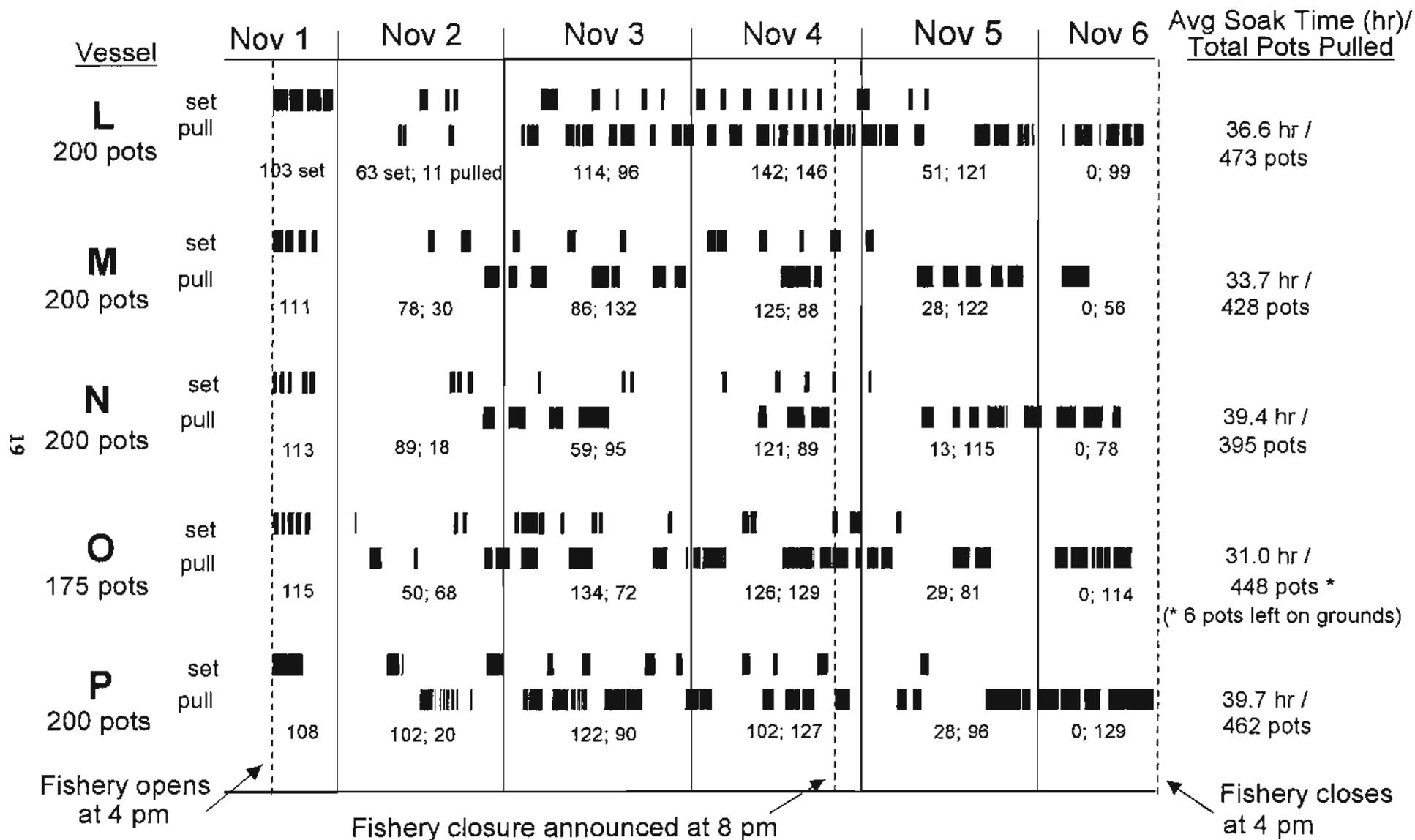
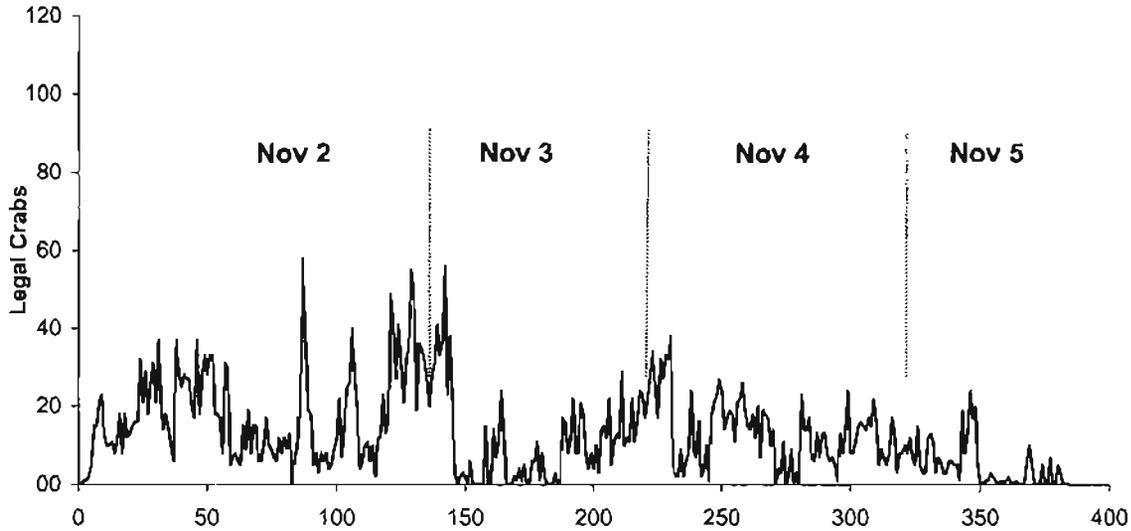


Figure 2. Frequency and number of pots set and pulled per vessel-day, average soak times and total pot pulls for 5 small vessels (<125') on which ADF&G biologists were deployed in the 1998 Bristol Bay red king crab fishery. Each hash mark (|) represents the time at which a pot was set or pulled.

Sequential Catch of Legal Crabs -- 1997

Vessel A



Vessel B

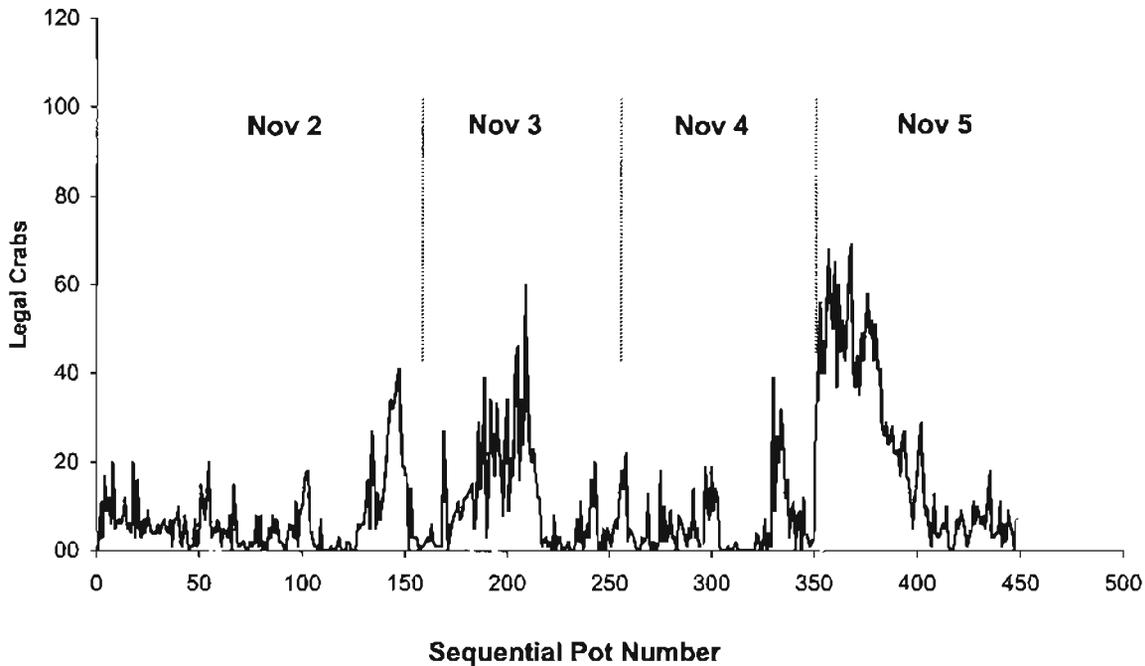
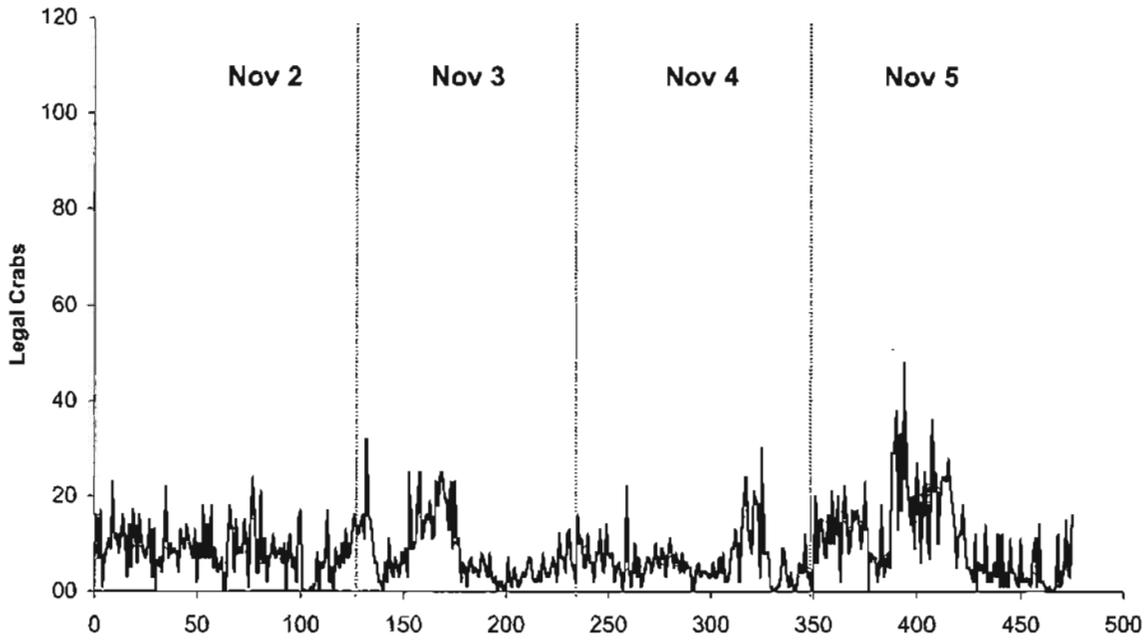


Figure 4. Catch of legally retained crabs from sequentially pulled pots for 7 vessels on which ADF&G biologists were deployed in the 1997 Bristol Bay red king crab fishery season. Data are from pilothouse logs (continued).

Sequential Catch of Legal Crabs -- 1997

Vessel C



Vessel D

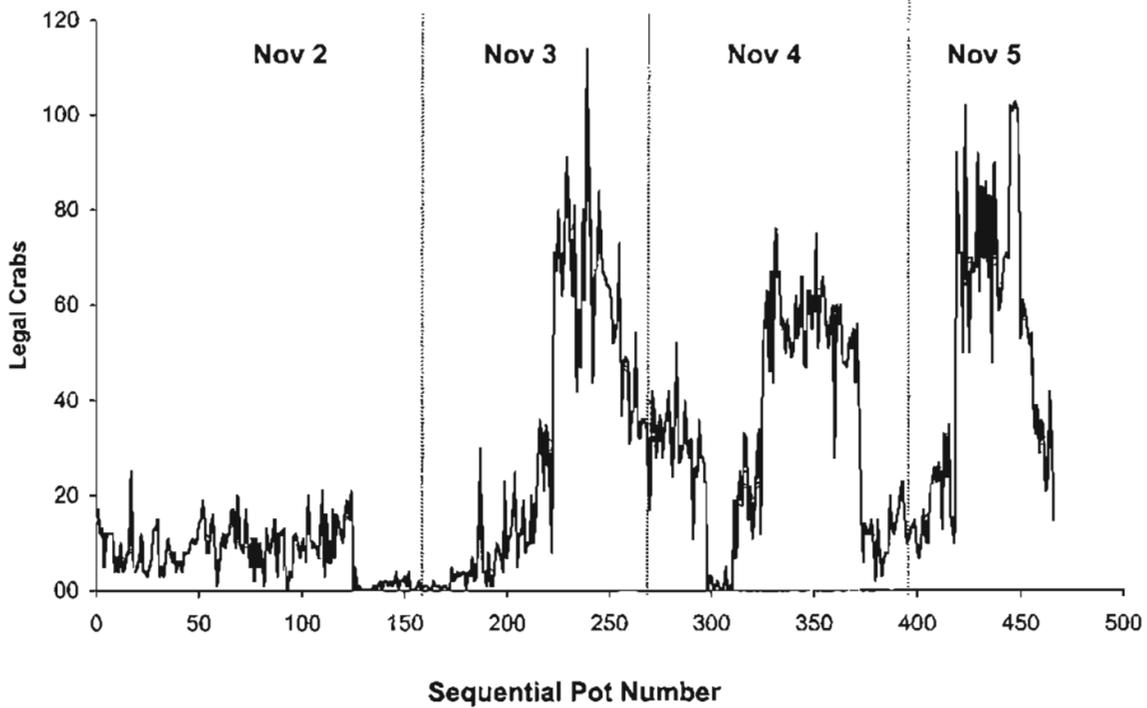
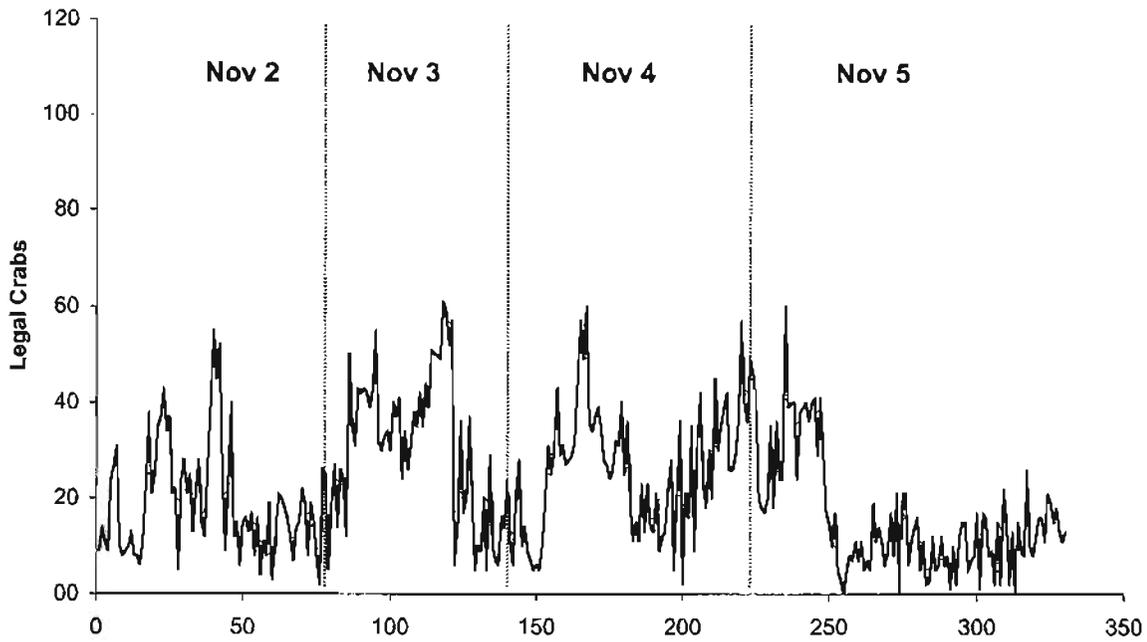


Figure 4. (page 2 of 4)

* Catch data available for 470 of 500 total pots pulled

Sequential Catch of Legal Crabs -- 1997

Vessel E



Vessel F

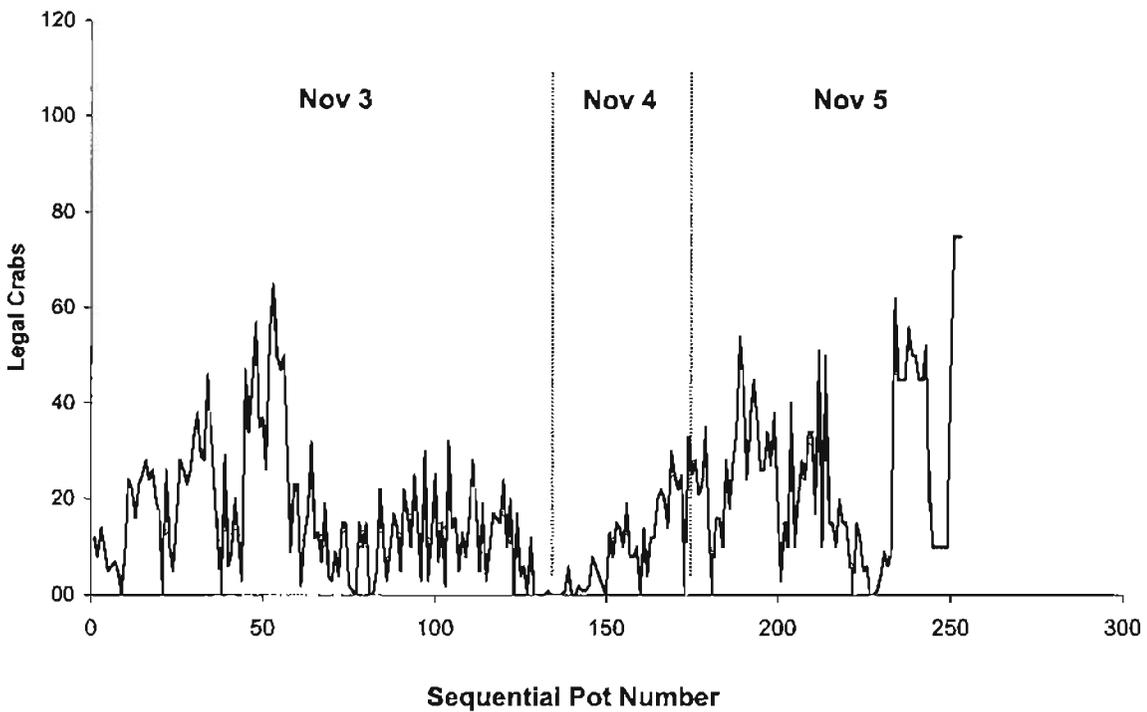


Figure 4. (page 3 of 4)

Sequential Catch of Legal Crabs -- 1997

Vessel G

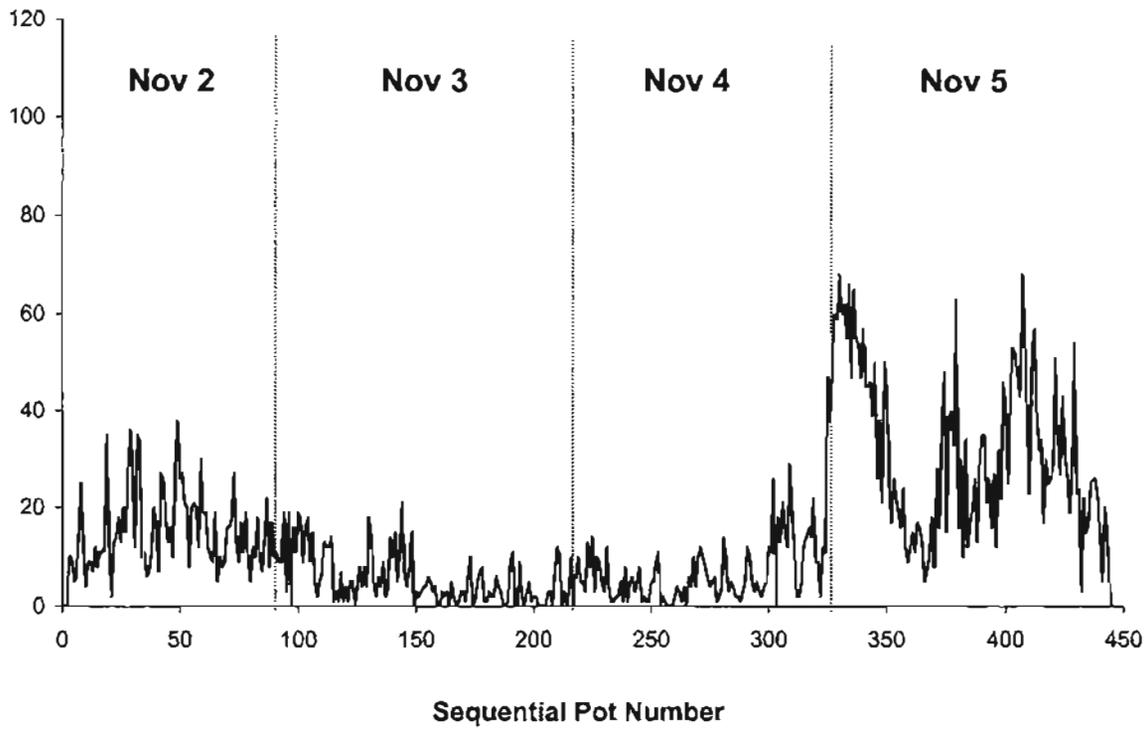


Figure 4. (page 4 of 4)

Sequential Catch of Legal Crabs -- 1998

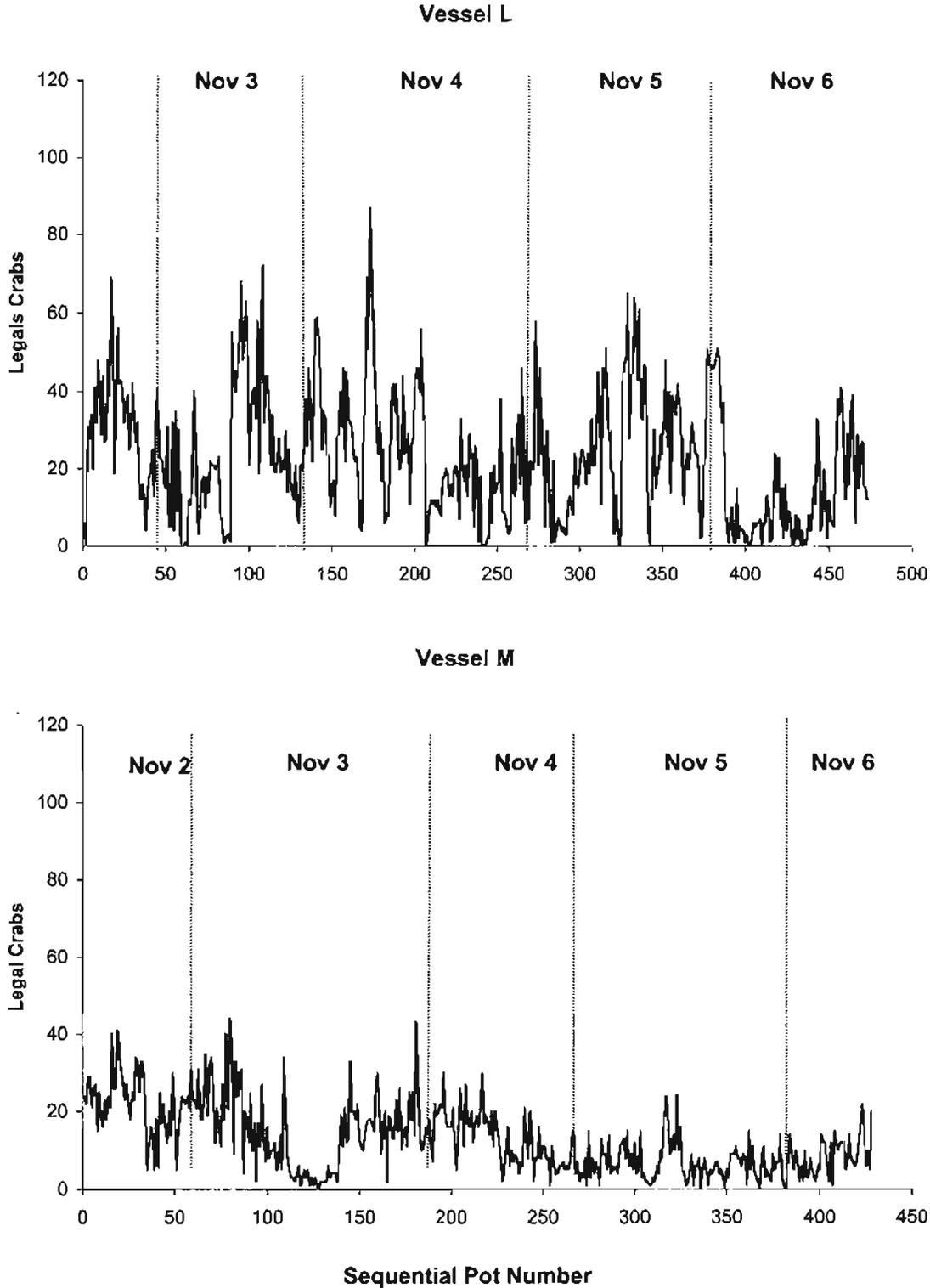


Figure 5. Catch of legally retained crabs from sequentially pulled pots for 10 vessels on which ADF&G biologists were deployed in the 1998 Bristol Bay red king crab fishery season. Data are from pilothouse logs (continued).

Sequential Catch of Legal Crabs -- 1998

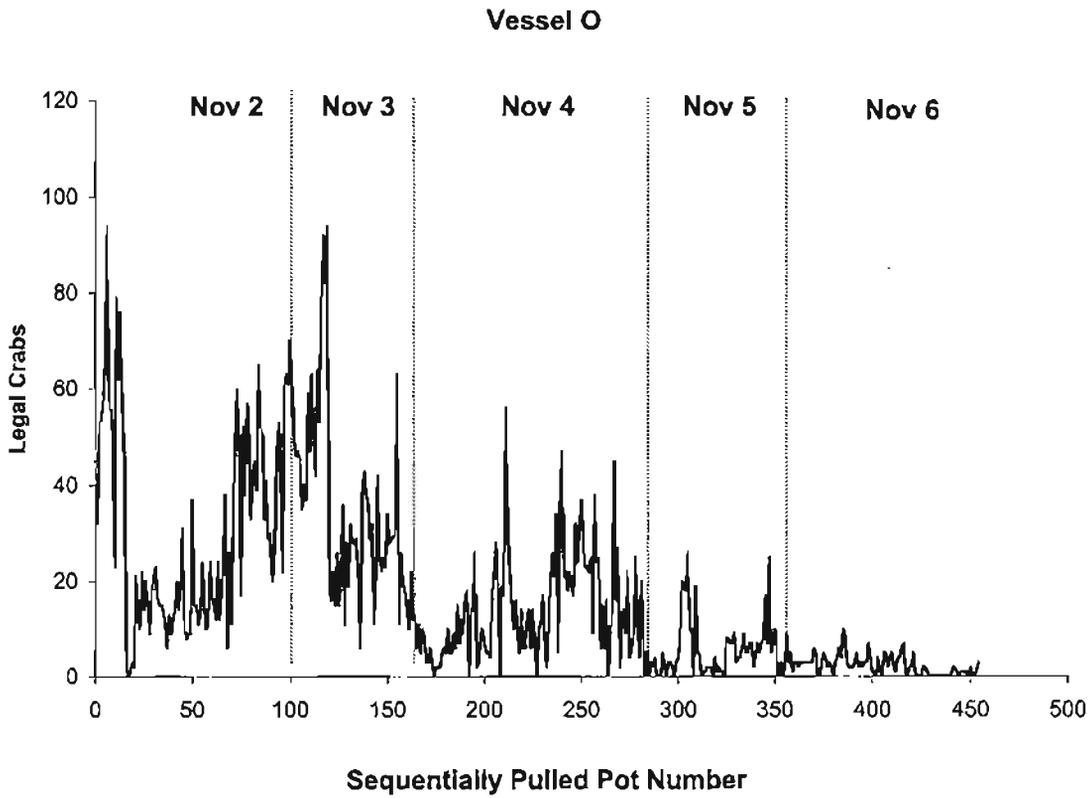
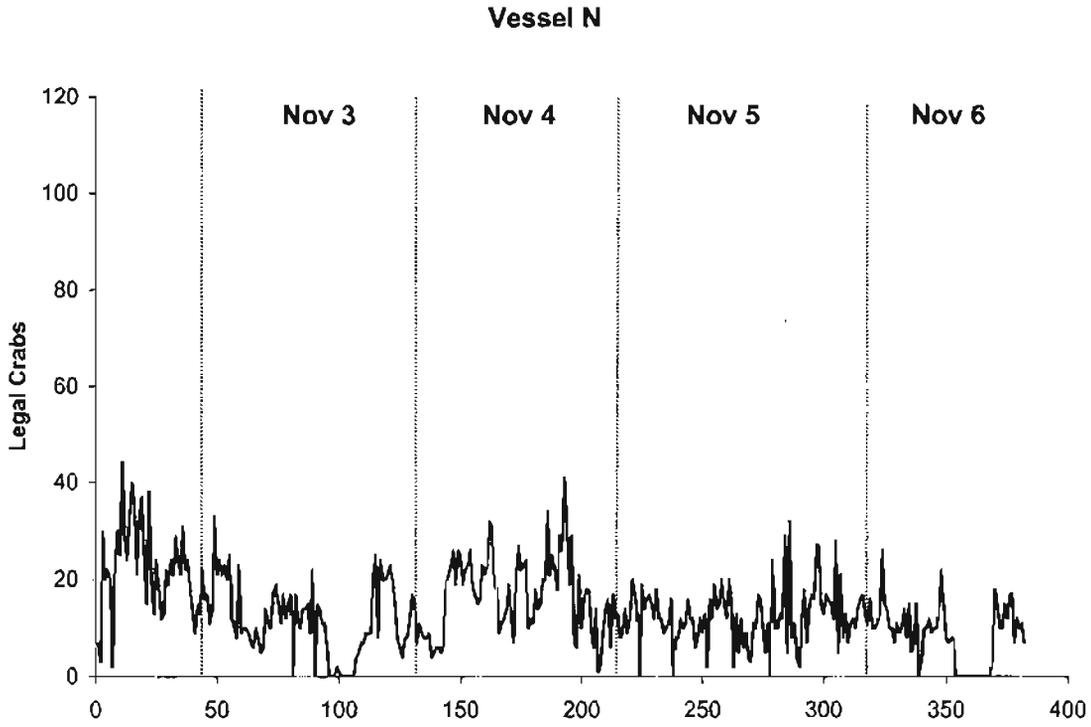
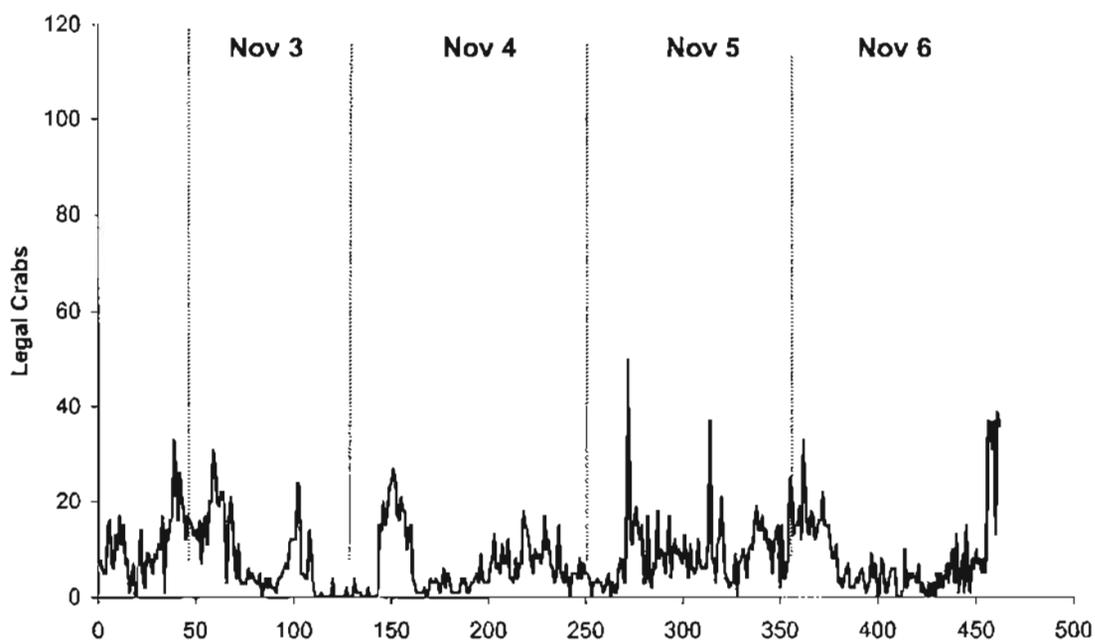


Figure 5. (page 2 of 5)

Sequential Catch of Legal Crabs -- 1998

Vessel P



Vessel Q

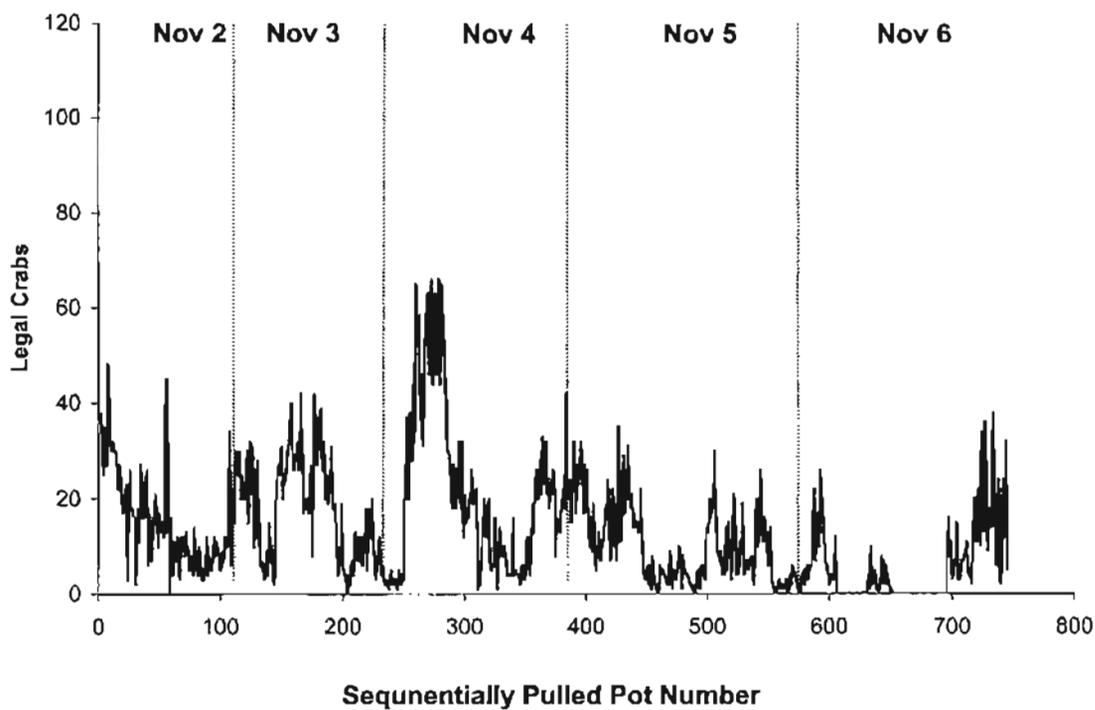
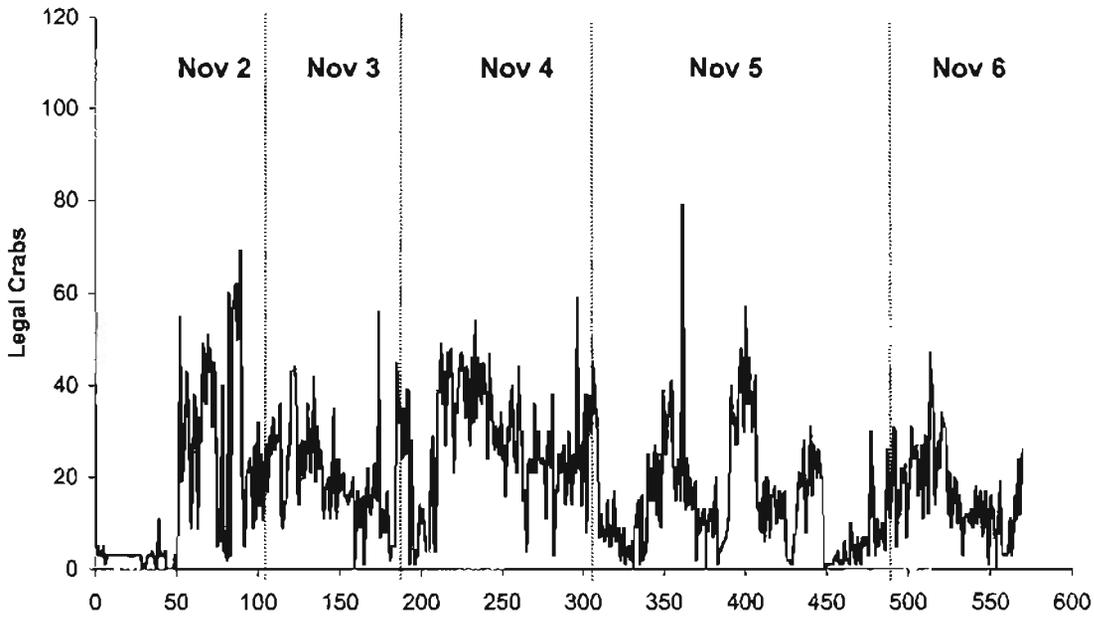


Figure 5. (page 3 of 5)

Sequential Catch of Legal Crabs -- 1998

Vessel R *



Vessel S

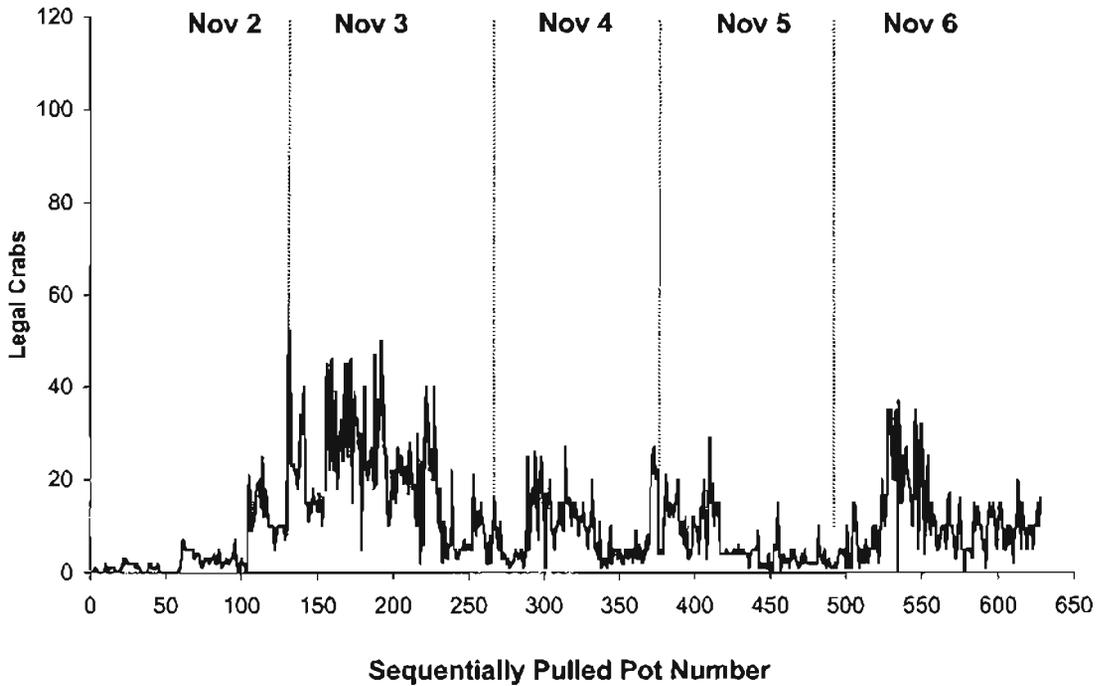
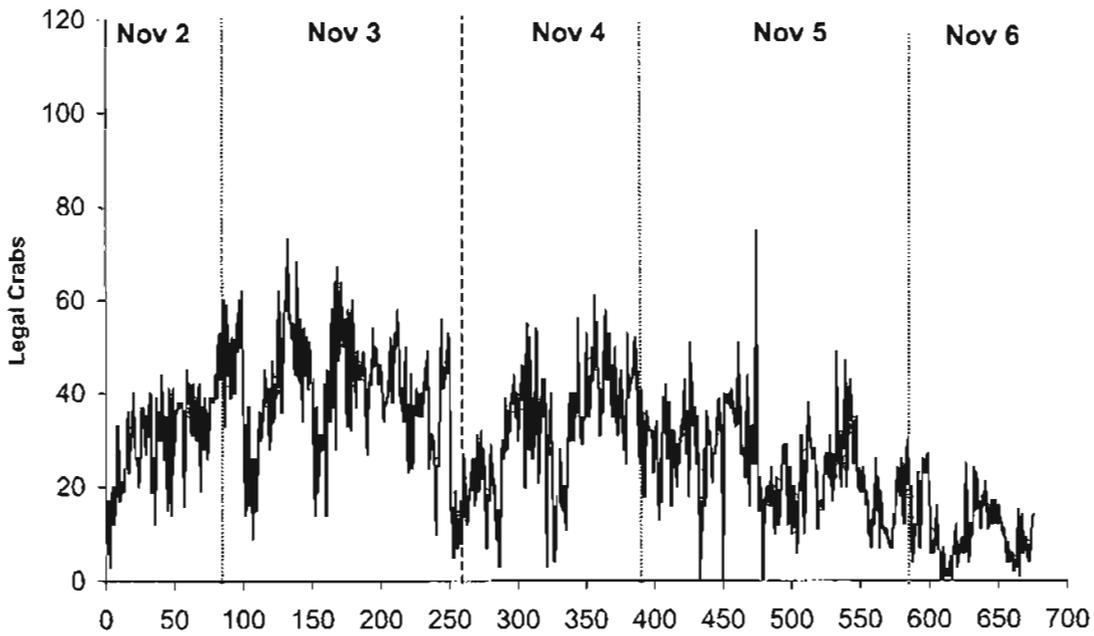


Figure 5. (page 4 of 5)

* Dates available for 570 of 601 pots pulled

Sequential Catch of Legal Crabs -- 1998

Vessel T



Vessel U

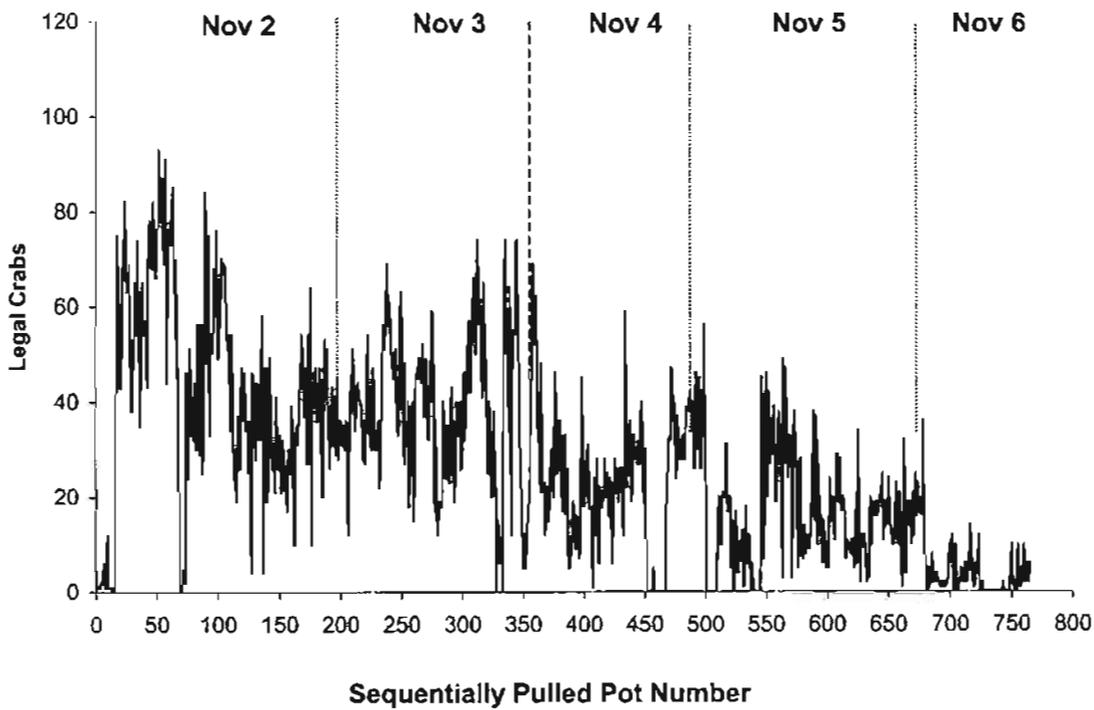


Figure 5. (page 5 of 5)

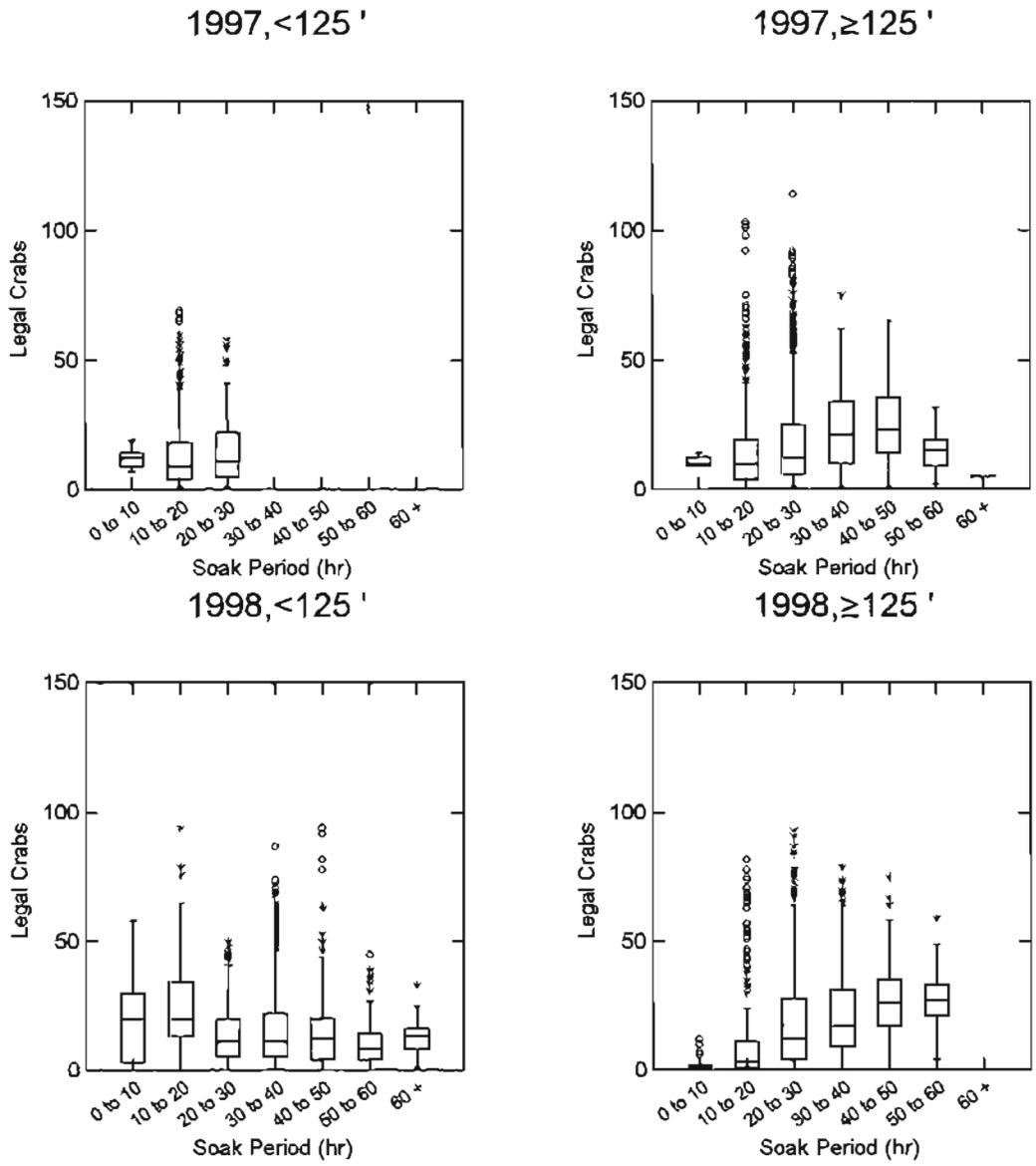


Figure 6. Box plots of legal male red king crabs caught per 10-hour soak period for large and small vessels in the 1997 and 1998 Bristol Bay red king crab fishery seasons. The horizontal line within each box represents the median (50 percentile) catch. Upper and lower bounds of the box represent the 25th and 75th percentile catches. Circles and asterisks indicate outlier data points.

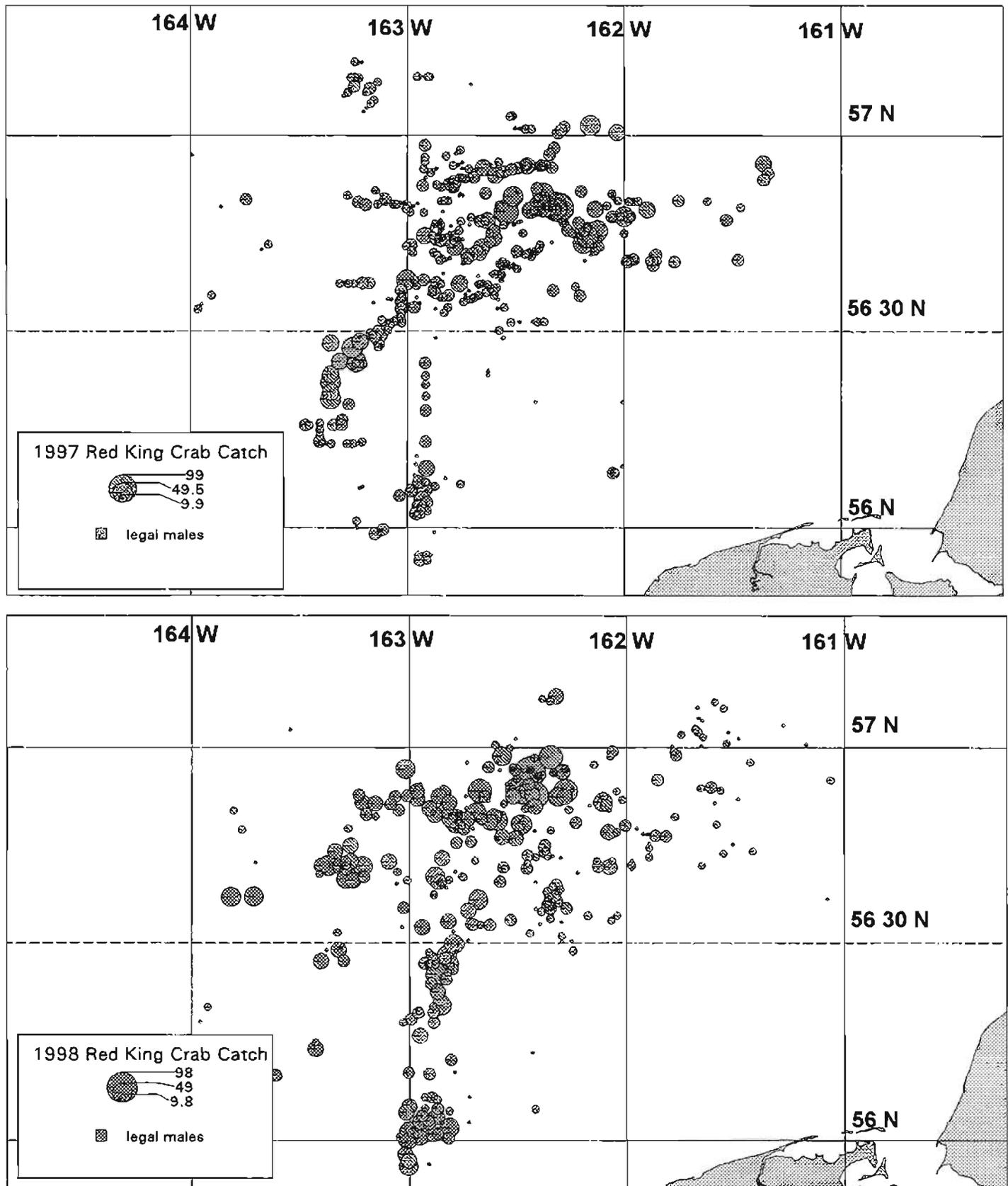
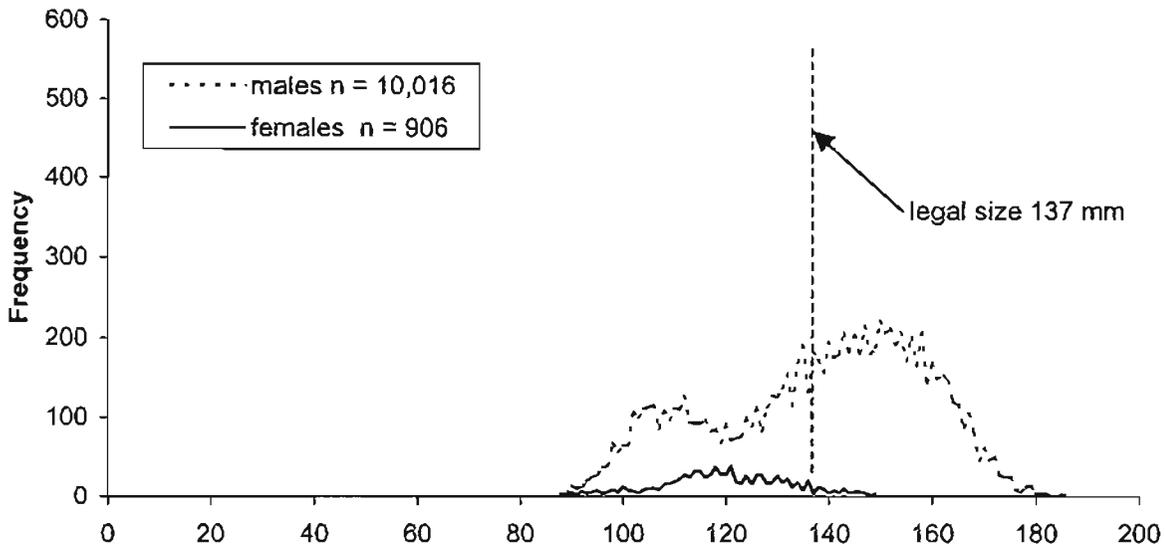
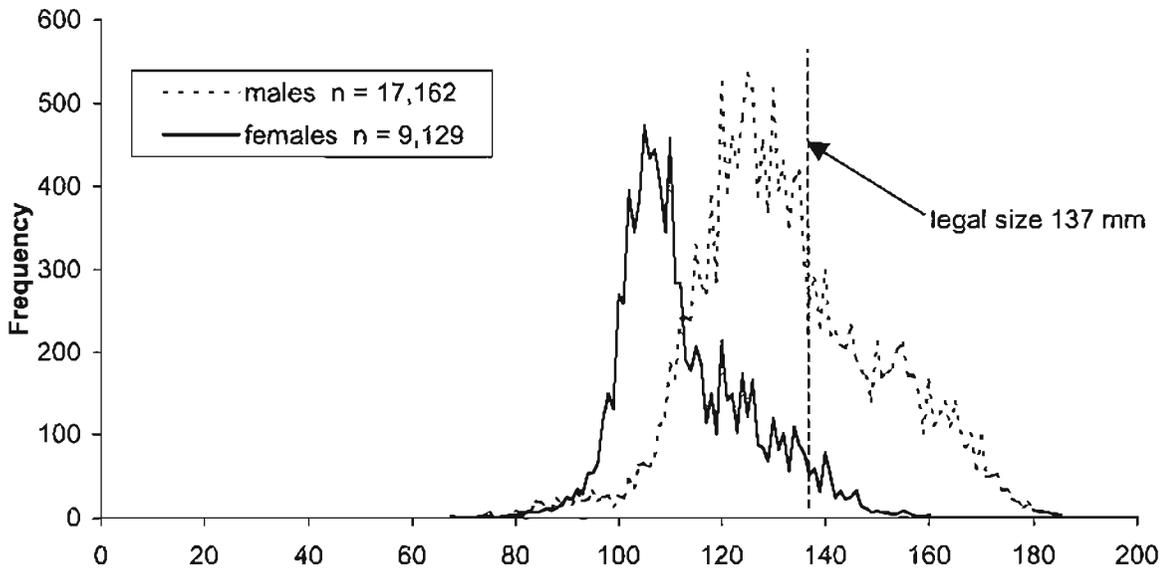


Figure 7. Distribution and relative size of catch of legal male red king crabs from bycatch pots sampled by ADF&G biologists and contract observers during the 1997 and 1998 Bristol Bay red king crab fishery seasons. Sample sizes are 600 pots in 1997 and 399 pots in 1998.

1997



1998



Carapace Length (mm)

Figure 8. Length frequency plots for male and female red king crabs sampled by contract observers and ADF&G biologists during the 1997 and 1998 Bristol Bay red king crab fishery seasons.

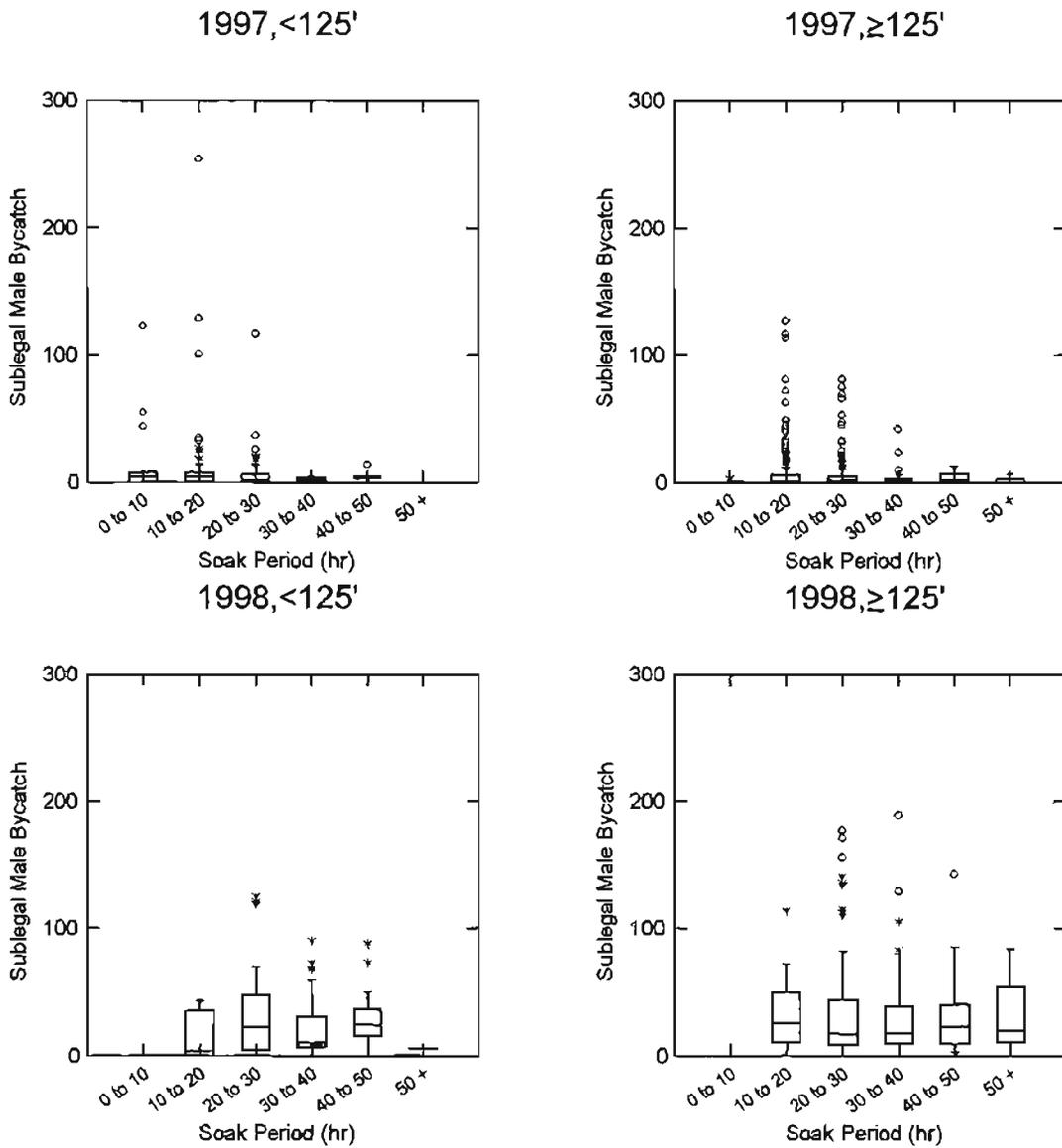


Figure 9. Box plots of sublegal male red king crab bycatch by 10-hour soak periods for large and small vessels in the 1997 and 1998 Bristol Bay red king crab fishery seasons. The horizontal line within each box represents the median (50 percentile) catch. Upper and lower bounds of the box represent the 25th and 75th percentile catches. Circles and asterisks indicate outlier data points.

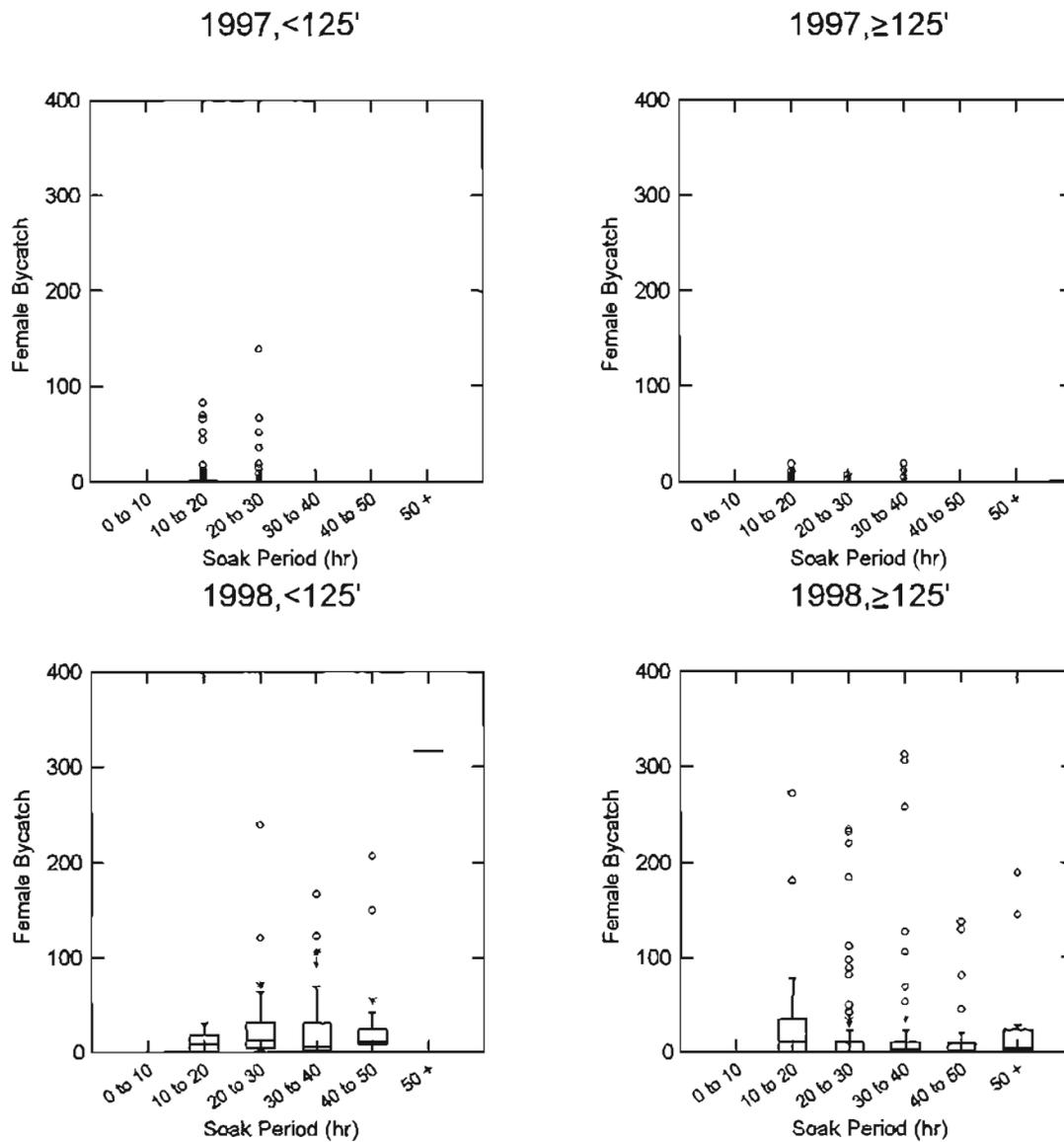


Figure 10. Box plots of female red king crab bycatch by 10-hour soak periods for large and small vessels in the 1997 and 1998 Bristol Bay red king crab fishery seasons. The horizontal line within each box represents the median (50 percentile) catch. Upper and lower bounds of the box represent the 25th and 75th percentile catches. Circles and asterisks indicate outlier data points.

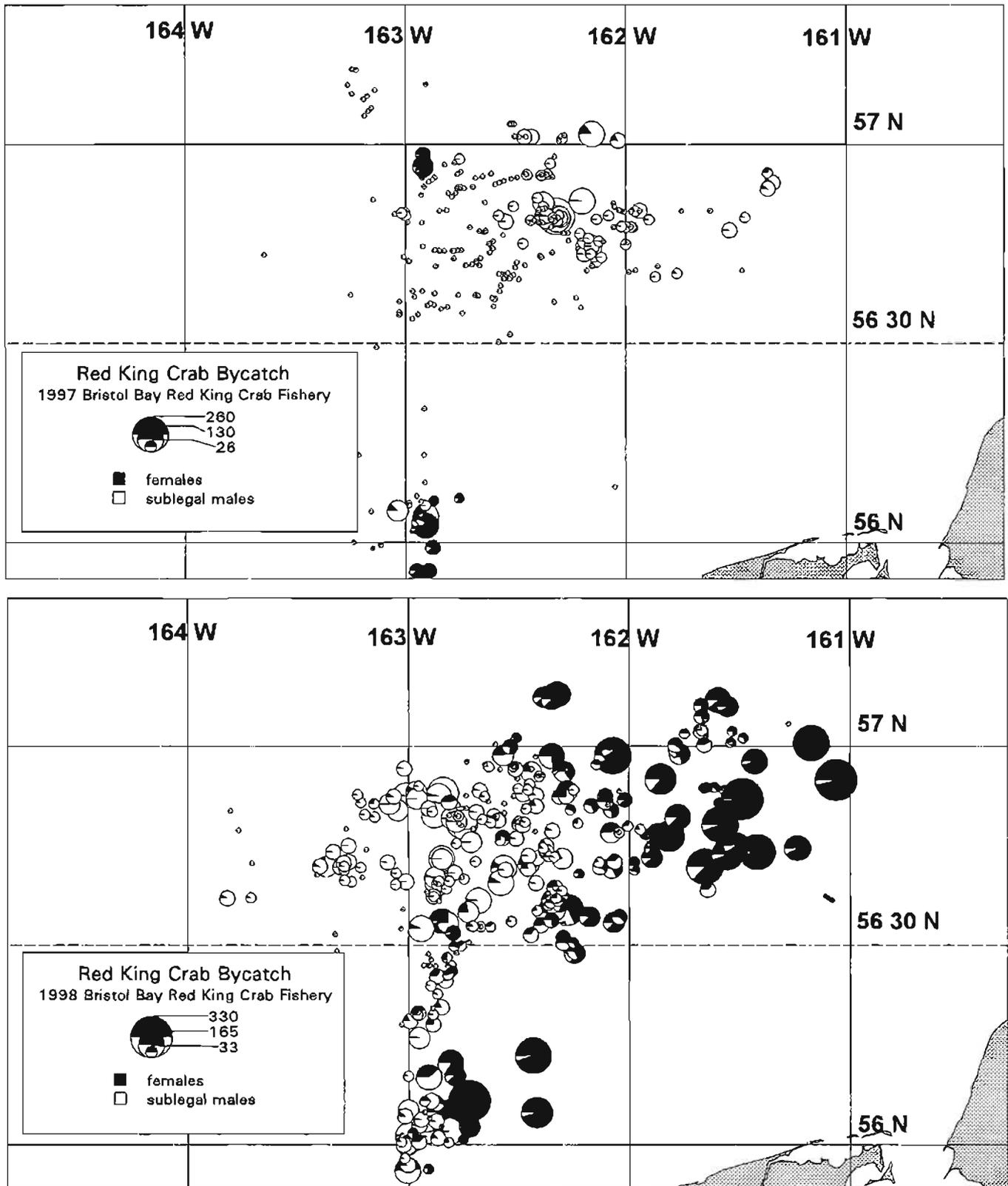


Figure 11. Distribution and relative size of catch of female and sublegal male red king crabs from bycatch pots sampled by ADF&G biologists and contract observers during the 1997 and 1998 Bristol Bay red king crab fishery seasons.

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