EFFECTS OF MODIFICATIONS TO COD-FISHING POTS ON CATCH RATES OF PACIFIC COD *Gadus macrocephalus*

By

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INTRODUCTION

Pot gear accounts for a large and increasing portion of the Tanner crab *Chionoecetes bairdi* bycatch in the Gulf of Alaska Pacific cod *Gadus macrocephalus* fishery. Estimated bycatch of Tanner crabs in the Gulf of Alaska cod pot fishery was 71,226 crabs during the 1996 season and 183,868 crabs during the 1997 season (NMFS 1998). Similarly, the percentages of the Pacific cod catch taken by pots has grown from 0% in 1984 to 22.5% in 1997 (NPFMC 1997). The need to develop crab-bycatch reduction measures in the cod pot fishery is indicated by the depressed status of affected crab stocks, expected effort increases in the pot fishery, and provisions in the Magnuson-Stevens Fishery Conservation and Management Act that place increased emphasis on reduction of incidental catch (NOAA 1997). In response, the Scientific and Statistical Committee of the North Pacific Fishery Management Council (NPFMC) has identified expanded research on gear modifications and other methods for reducing bycatch as its top research priority relative to bycatch problems. Fortunately, pots offer more design options for reducing bycatch than most other fishing gear (Miller 1996). In particular, testimony presented to the NPFMC in 1996 suggested that significant reductions in crab bycatch in the cod pot fishery could be effected by simple alterations to cod pots.

In this report we present results from the second phase ("Phase II") of a study on the effects of some low-cost modifications to standard cod-fishing pots on the catch rates of Pacific cod and Tanner crab. Phase II of the study focused on catch rates of Pacific cod, but Tanner crab bycatches are also enumerated in this report. However, results from the previous phase ("Phase I") of our study that focused on the effectiveness of these same pot modifications on Tanner crab bycatch rates have been presented in an earlier report (Watson et al. 1998a).

METHODS

Pot Design and Modifications

All known pot fishers and pot manufacturers participating in Alaskan crab or cod fisheries were solicited during June through August 1997 for ideas on alterations to standard cod pots that would reduce Tanner crab bycatch but maintain catch rates of cod. Three designs were chosen based on presumed effectiveness, on corroborative information supplied by designers, and on feasibility of the alterations for use in a commercial fishery. All alterations chosen for study were designed to inhibit the entry of Tanner crabs into cod pots.

All designs studied in this project involve modifications to standard cod pots, that is, rectangular king crab pots with tunnel eyes modified for groundfish consistent with 5 AAC 28.050 (e) (ADF&G 1997). A total of 20 individual pots, five of each of the four pot types, were made for use in this study by modifying existing king crab pots. Each of the three modified cod pots were evaluated against the standard cod pot and each of the three modified pots were fitted as standard cod pots prior to modification as described below.

Standard Cod Pot: A commercial size crab pot measuring 198 cm x 198 cm x 76 cm (6½ ft x 6½ ft x 2½ ft), with two opposing 20.3 cm x 91.4 cm (8 in x 36 in) vertically placed tunnel eye openings. Each tunnel eye was fitted with cod triggers. Halibut-excluder devices were placed vertically in each tunnel eye every 22.9 cm (9 in) (Figure 1). Each pot was webbed with 7.6 cm (3 in) stretched mesh.

False-tunnel Modification: A standard cod pot fitted with a trapezoidal web panel attached to the lower edge of the tunnel eye, extending horizontally and parallel to the bottom of the pot, outward to the tunnel sides at a height of 25.4 cm (10 in) from the base of the pot (Figure 2).

Slick-ramp Modification: A standard cod pot fitted with a trapezoidal panel of 2-mm thick hard plastic attached flush to the tunnel ramp from the lower edge of the tunnel eye outward to the base of the tunnel and extending 10.2 cm (4 in) up the tunnel sides (Figure 3).

Vertical-board Modification: A standard cod pot fitted with 2.5 cm x 20.3 cm x 19.8 m (1 in x 8 in x 6½ ft) planed pine boards installed lengthwise across the bottom of each tunnel and flush with the bottom frame and lower 20.3 cm (8 in) of each side of the tunnel (Figure 4).

Sampling Design

The study was performed in an area of known Pacific cod concentrations in the Kupreanof Strait area, Kodiak, Alaska. Depths fished ranged from 83 m (45 fm) to 123 m (67 fm). A total of 16 pots (four standard cod pots and four of each of the three modification types) were fished concurrently. Each pot was baited with two hanging net bags each containing 2.2 kg (5 lb) of chopped frozen herring. The 16 pots were set in four groupings of four pots each. Each group of four pots (referred to in this report as a "quad") consisted of a standard pot and one of each of the three modification types. Pots in a quad were set at the corners of a square with 0.24 km (0.13 nmi) sides. The arrangement by pot type within each quad was determined randomly and independently of other quads (Watson et al. 1998b). The separate quads were spaced a minimum of 0.93 km (0.5 nmi) apart and in any array (e.g., square, rectangle, line, or curved) necessary to enable placement within concentrations of Pacific cod. An example deployment of the 16 pots is provided in Figure 5. Sampling took place aboard the 27.4-m (90-ft) research vessel RV *Resolution* in a 9 day period during March 11-20, 1998. A total of 176 pot lifts in 44 quads were successfully performed (Appendix A).

Interviews with commercial cod pot fishers in the Kodiak Area state waters fishery indicate that soak times in the commercial fishery are generally in the range of 6 hr to 12 hr (pers. comm. C. Worton, ADF&G, Kodiak). Considering fishery data and the study vessel-operating schedule, two target soak time goals were established for each quad: 6 h and 16 h. Soak time for pots in 16 quads had a target of 6 h, but had actual soak times of 5.6 to 7.1 h. Pots in 24 quads had a target soak time of 16 h, but had actual soak times of 16.5 to 18.4 h. Pots in an additional 4 quads soaked 3 d due to poor weather that precluded sampling on the preferred 6 hr and 16 hr soak schedule.

Board Material and Orientation Sub-Study

Three paired comparisons of two different vertical-board modifications were conducted to investigate the effects of board orientation and wood type on the catch rate of cod. Test pots were: 1) a vertical-spruce-board pot, configured identically to the original vertical-board pot but using spruce wood instead of pine wood for the board; and 2) a horizontal-pine-board pot, configured identically to the standard cod pot, but with a pine wood board affixed inside and flush to the bottom of the pot at each tunnel entrance. The two pot types were set in pairs and spaced 0.24 km (0.13 nmi) apart. The pairs of pots were set three times over 3 days with soak times of 6, 16 and 18 h. Due to the low number of paired comparisons no statistical tests were performed on the results from this sub-study.

Catch Sampling and Data Recording

Catch of each species (or species group) was enumerated as detailed in Watson et al. (1998b). All captured Pacific cod were counted and measured (fork length). Crabs were separated by species and sex. Any Tanner crabs that were retained on the outside surface of the pot were enumerated separately from crabs captured inside the pot. Sex, shell age, carapace width (CW), legal ($\geq$ 140 mm CW, including spines) or sublegal status of males, juvenile or adult status of females, and reproductive condition of females was recorded from Tanner crabs. All captured animals were returned to the sea near the pot lift site after sampling.

Data Analysis

Statistical Tests for Significance of Variation in Pacific Cod Catch Rates among Pot Types

Only data from quads in which at least one Pacific cod was captured were included in the analysis of Pacific cod catch rates. Catch per pot (CPUE) was first examined for each pot type by soak time (6 h, 16 h, and 3 d) prior to performance of statistical tests to determine if any trends attributable to soak time existed that would have warranted blocking by soak time.

Pacific cod CPUE was analyzed according to a repeated measure model in which the data from a single quad was treated as a four-variate random variable (with CPUEs for each of the four pot types as the four components of the random variable). Results for one quad were assumed to not influence the results of any other quad (that is, the four-variate random variables were assumed to be mutually independent). Pot types within each quad were ranked on the basis of Pacific cod catch from 1 (lowest catch of Pacific cod for quad) to 4 (highest cod catch for quad). Friedman's test (Conover 1971) was used to test the null hypothesis,

H_0: Each ranking of pot type by Pacific cod CPUE within a quad is equally likely,

against the alternative hypothesis,

H_1: At least one of the pot types tends to yield larger Pacific cod CPUEs than at least one other pot type.

If the above null hypothesis was rejected at P=0.05 by Friedman's test, the procedure for multiple comparisons following Friedman's test (Conover 1971) was used to test the significance of differences in cod catch between pairs of pot types. Two pots types were considered to differ significantly in cod catch if the null hypothesis of no effect due to pot type was rejected at P=0.5 by the multiple comparison test.

RESULTS

Effects of Pot Types on Pacific Cod Catches

All of the 44 four-pot quads that were successfully set and retrieved during the study produced a catch of at least one Pacific cod (Table 1). A total of 2,015 Pacific cod were captured in this study.

Pacific Cod CPUE

Pooling data from all soak times, false-tunnel pots had the highest overall cod CPUE for 44 pot lifts at 18.4 cod per pot, followed in descending order by standard cod pots (15.9), slick-ramp pots (10.8), and vertical-board pots (0.7) (Table 1). That trend in cod catch by pot types was consistent across soak time categories. Within-quad ranking of pot types by catch of Pacific cod showed the same trends as CPUE. On the 1-to-4 scale of ranking pot types within quads by catch of Pacific cod, the within-quad ranks of the false-tunnel pots averaged highest over the 44 quads at 3.3, followed in descending order by standard cod pots (3.1), slick-ramp pots (2.5) and vertical-board pots (1.1). Maximum observed Pacific cod catch for a single pot lift by pot type followed the same trend as CPUE by pot type. The highest catch of cod in any single pot lift occurred when a false-tunnel pot soaked for 3 d and captured 40 cod. The highest catch of Pacific cod in a single lift of a standard cod pot was 38, followed by the maximum catch of a slick-ramp pot (34). The maximum catch for vertical-board pots was 15 cod, well below that of the other three pot types. Standard cod, false-tunnel, and slick-ramp pots each produced a catch of Pacific cod in all quads. By comparison, vertical-board pots were notable in failing to capture cod in 33 of the 44 quads. Catch of Pacific cod tended to increase with soak time in standard and false-tunnel pots and to decrease with soak time in slick-ramp pots. Such trends may, however, be due to sampling error and the low number of trials at a 3-d soak. Catch of Pacific cod remained notably low regardless of soak time in vertical-board pots.

Since similar trends in ranking of pot types by Pacific cod catch were exhibited at all soak times, we pooled the data from all 44 quads that produced a catch of cod regardless of soak time for performing statistical tests. The null hypothesis of no trend in ranking of pot types by Pacific cod catch within quads was rejected by Friedman's test (Friedman test statistic = 85.2, $P<<0.00001$ for F-distribution with $df_1=3$, $df_2=129$). The multiple comparison tests following

the Friedman test showed no significant difference between the standard cod pot and the false-tunnel pot. The lower CPUEs for the slick-ramp pots and for the vertical-board pots were statistically significant, however; all pair-wise comparisons of CPUE between pot types involving either the slick-ramp pots or the vertical-board pots were statistically significant.

Pacific Cod Size Composition

There was no indication of difference in cod fork length distributions among pot types. Cod ranged in size from 37 cm to 93 cm, but most (90%) were between 50 cm and 70 cm (Figure 6).

Board Material and Orientation Sub-Study

Out of the three paired-pot trials performed, the horizontal-pine-board pot consistently caught cod while the vertical-spruce-board pot captured cod only once (Table 2). Catch of cod produced by the horizontal-pine-board pot was well within the range observed for standard, false-tunnel, and slick-ramp pots soaked for 6 h or 16 h during this study (Table 1). The catch of cod in the one set of the vertical-spruce-board pot that produced a catch of cod was comparable to the catch for the horizontal-pine-board pot in the same pair.

Incidental Species Composition

Yellow Irish lords *Hemilepidotus jordani* dominated incidental species catches in all pot types, with highest catches observed in standard pots (244) and slick-ramp pots (237). Snails (ribbed neptunes *Neptunea lyrata* and hairy tritons *Fusitriton oregonensis)* were fairly numerous in all pot types excluding vertical-board pots. Octopus *Octopus dofleini* were caught in all pot types; however, more were caught in standard and slick-ramp pots (9 and 11 animals, respectively) than in false-tunnel and vertical-board pots (4 and 1 animals, respectively). Tanner crabs *Chionoecetes bairdi* were rarely encountered; 3 crabs were caught in standard pots and one crab was caught in a slick-ramp pot. A summary of incidental species caught during the study is shown in Table 3.

DISCUSSION

Results from Phase II of the cod pot modification study reported here confirm the effects on Pacific cod catch rates observed during Phase I (Watson et al. 1998a). The false-tunnel modification showed no effect of diminishing cod catch relative to a standard cod pot and it was demonstrated that the slick-ramp and vertical-board modifications both reduce cod catch rates relative to a standard cod pot. Unlike Phase I, however, in Phase II it was also possible to demonstrate that the vertical-board modification reduces cod catch rates relative to the slick-ramp modification.

The agreement in findings on effects to cod catch rates during Phase II and Phase I occurred despite some notable differences in seasonality, locality, and fishing procedures between the two study phases. Phase I of the modified cod pot study was conducted in November 1997 in Chiniak Bay, northeast Kodiak Is., at an average depth of 79 f. Distribution of Pacific cod during fall-winter months in nearshore areas is known to be diffuse as cod move to deeper shelf waters (Kasahara 1961). By contrast, Phase II was conducted in spring in Kupreanof Strait, northwest Kodiak Is., at depths averaging 54 f, during the period that cod are aggregating to spawn. Overall, cod catches in Phase II were nearly double (2,015) that of Phase I cod catches (1,156) from each of the 44 four-pot quads that were successfully set and retrieved during each phase. However, each quad in both phases of the study caught at least one cod. Additionally, soak times were generally much shorter during Phase II than in Phase I: 40 of the 44 quads fished during Phase II were soaked for roughly 16 h or less whereas 39 out of 44 quads fished during Phase I had soak times of 24 h or greater.

Our results from the board material and orientation sub-study may be considered inconclusive since they were not tested statistically due to the small number of observations. However, the poor performance of the vertical-board pots in both study phases is notable: these pots were the least effective pot for catching Pacific cod in Phase I and Phase II, and also for catching Tanner crabs during Phase I. Additional comparisons of board material and orientation are necessary in order to determine the causes of the dramatically low catch rates that vertical-board pots incur.

In conclusion, this study indicates that the false-tunnel pot modification maintains Pacific cod catch rates equivalent to, or exceeding those of the standard cod pot. Moreover, with the exception of the vertical-board pot, the false-tunnel pot caught significantly fewer Tanner crabs than either the standard or the slick-ramp pots during the first phase of the project (Watson 1998a). To-date, the false-tunnel pot surpasses all other pot types examined in effectiveness at reducing bycatch of Tanner crabs while maintaining catch rates of Pacific cod.

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Table 1. Pacific cod catch per pot by pot type and soak time from the March 1998 Alaska Department of Fish and Game modified cod pot study conducted in Kupreanof Strait, Alaska.

Pot Type	Soak Time			
	6 h[a] (n[c]=16)	16 h[b] (n=24)	3 d (n=4)	All Soaks (n=44)
Standard Cod Pot	15.4 (6-32)[d]	15.2 (3-35)	22.3 (14-38)	15.9 (3-38)
False-tunnel Pot	17.5 (5-32)	18.0 (2-38)	25.0 (16-40)	18.4 (2-40)
Slick-ramp Pot	12.1 (1-34)	10.5 (1-20)	7.3 (2-17)	10.8 (1-34)
Vertical-board Pot	1.1 (0-15)	0.3 (0-2)	1.5 (0-3)	0.7 (0-15)

[a] Actual soak times ranged from 5.6 to 7.1 h.
[b] Actual soak times ranged from 15.1 to 18.4 h.
[c] Number of pots pulled for each pot type.
[d] Minimum and maximum catches.

Table 2. Catch of Pacific cod catch per pot by pot type and soak time from the board material and orientation sub-study during the March 1998 Alaska Department of Fish and Game modified cod pot study conducted in Kupreanof Strait, Alaska.

Test Number	Pot Type	
	Horizontal Pine Board	Vertical Spruce Board
1	14	0
2	8	0
3	9	8

Table 3. Incidental species caught during the March 1998 Alaska Department of Fish and Game modified cod pot study conducted in Kupreanof Strait, Alaska.

	Pot Type[a]				
Species	1	2	3	4	Total
Yellow Irish Lord	244	44	237	9	534
Great Sculpin	3	0	3	0	6
Plain Sculpin	1	0	0	0	1
Walleye Pollock	13	15	7	0	35
Whitespotted Greenling	2	0	0	0	2
Kelp Greenling	0	1	0	0	1
Redbanded Rockfish	0	1	0	0	1
Pacific Halibut	3	0	0	0	3
Flathead Sole	2	0	0	1	3
Yellowfin Sole	2	0	1	0	3
Butter Sole	1	0	0	0	1
Tanner Crab	3	0	1	0	4
Lyre Crab	3	0	0	0	3
Ribbed Neptune	16	25	28	1	70
Hairy Triton	21	36	63	0	120
Buccinum sp.	1	1	0	0	2
California Mussel	0	0	1	0	1
Chlamys sp.	1	3	0	0	4
False Jingle	0	3	0	0	3
Octopus	9	4	11	1	25
Starfish Unid.	0	0	2	0	2
Sunflower Starfish	1	1	1	0	3
Basketstarfish Unid.	0	1	0	0	1
Green Sea Urchin	11	28	43	2	84
Sand Dollar Unid.	0	1	0	0	1
Sponge Unid.	1	0	0	0	1

[a] Pot Type: 1=Standard Cod Pot; 2=False-tunnel Pot; 3=Slick-ramp Pot; 4=Vertical-board Pot

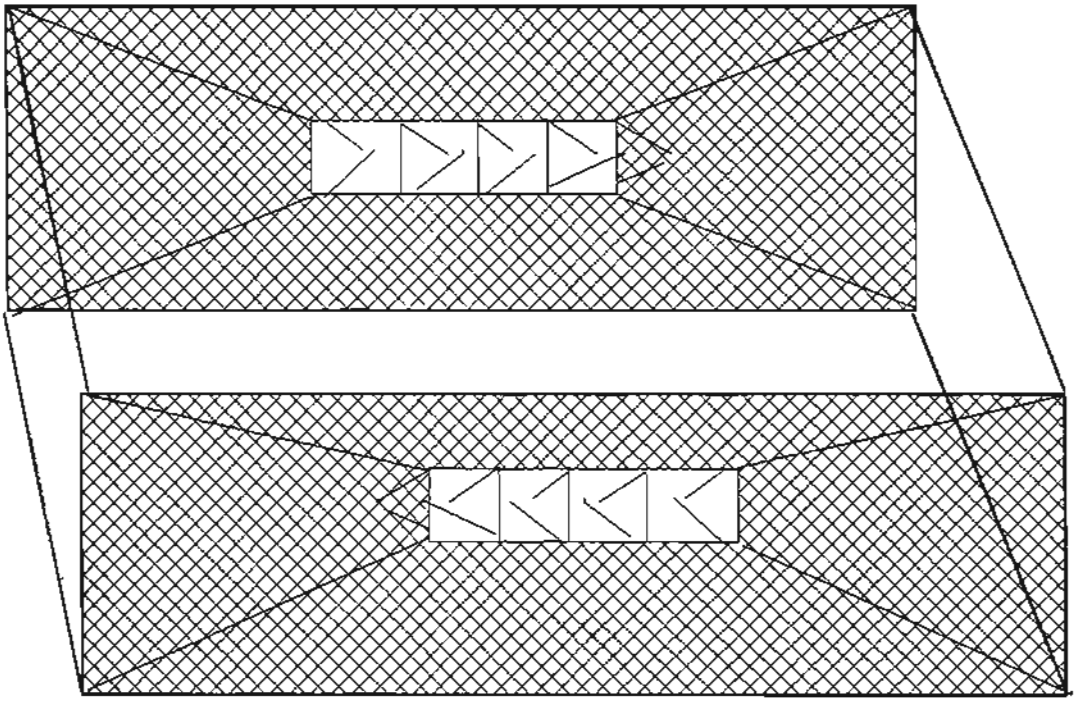


Figure 1. Standard cod pot with cod triggers and vertical halibut excluders installed in each tunnel eye.

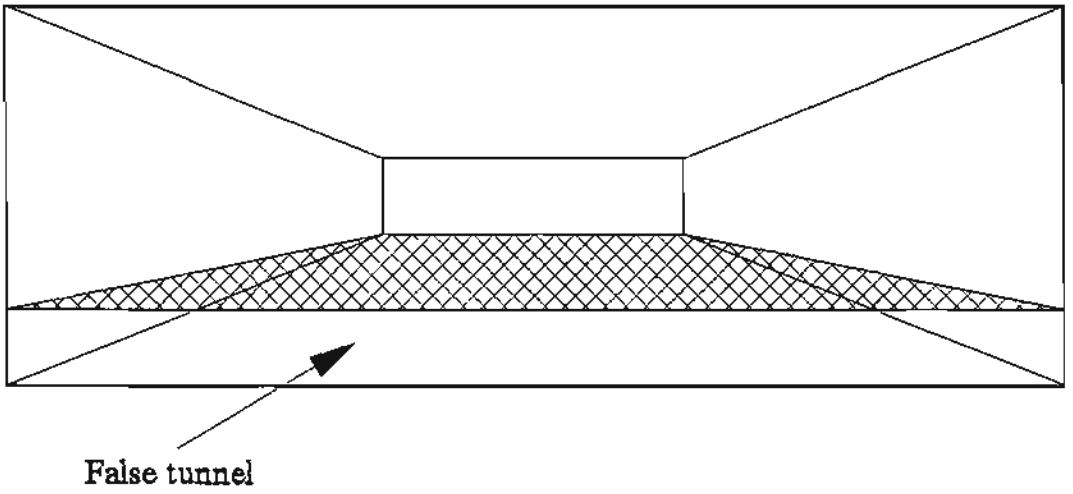


Figure 2. False tunnel modification to a standard cod pot. Cod triggers and halibut excluders are not shown so that the trapezoidal web panel is clearly shown.

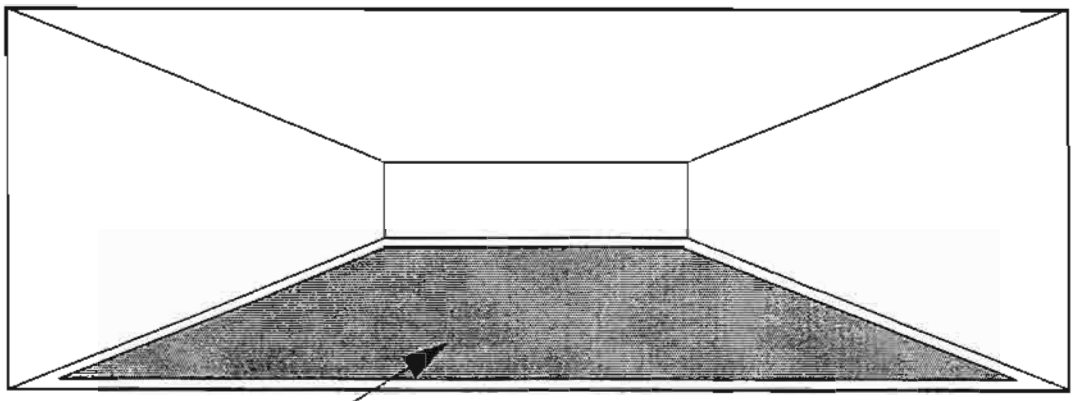


Figure 3. Slick tunnel ramp modification to a standard cod pot. Cod triggers and halibut excluders are not shown so that the trapezoidal plastic tunnel ramp is clearly shown.

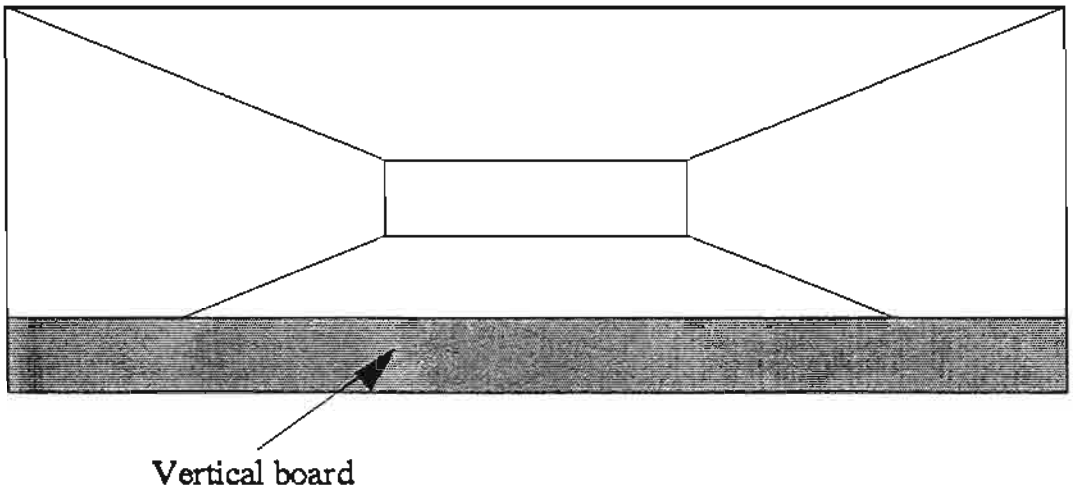
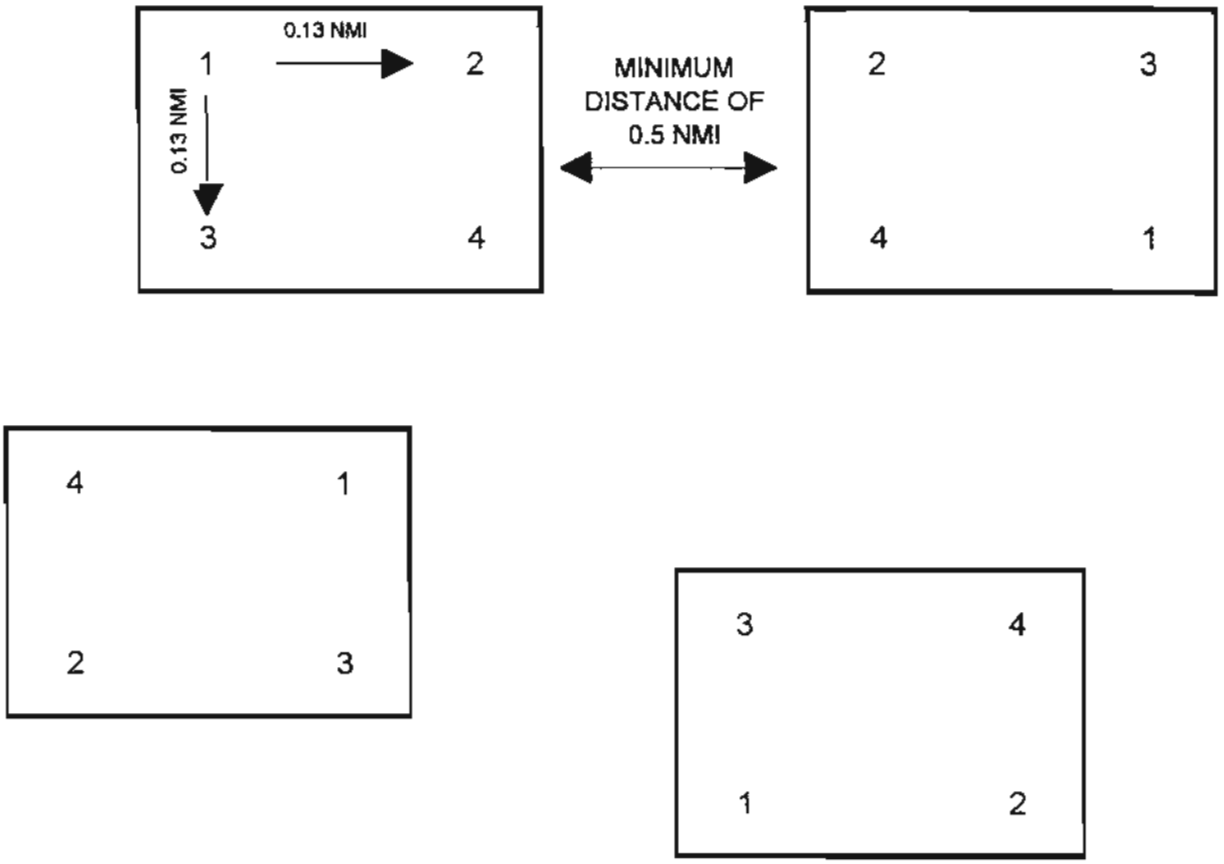


Figure 4. Vertical board modification to a standard cod pot. Cod triggers and halibut excluders are not shown so that the vertical board is is clearly shown.



1 = Standard Cod Pot (King crab pot modified for cod fishing)

2 = False Tunnel Pot (Standard Cod Pot with reverse angle web panel)

3 = Slick Tunnel Ramp Pot (Standard Cod Pot with slick tunnel ramp insert)

4 = Vertical Board Pot (Standard Cod Pot with vertical board at base of tunnel mouth)

Figure 5. Sample pot deployment pattern showing placement of 16 pots. One of each pot type per quad is randomly placed approximately 0.13 nmi apart. The quads are a minimum distance of 0.5 nmi apart but can be laid out in any direction from each other.

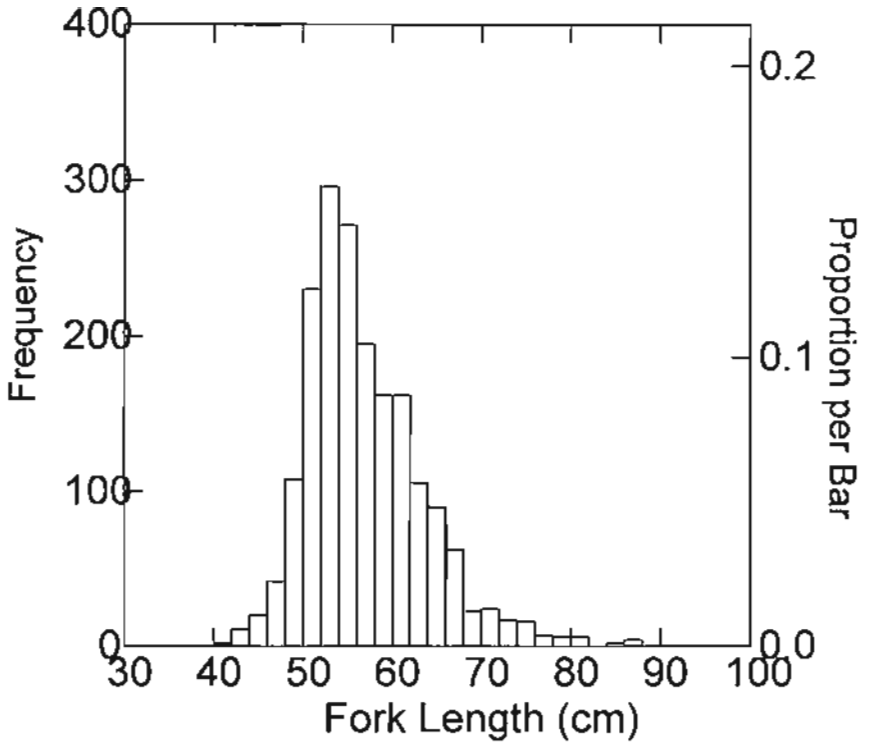


Figure 6. Size (fork length) frequency distribution for all Pacific cod captured during the March 1998 Alaska Department of Fish and Game modified cod pot study conducted in Kupreanof Strait, Alaska.

APPENDIX

Appendix A. Pot location data and catches of Pacific cod and Tanner crabs from 176 pots fished on the March 1998 Alaska Department of Fish and Game modified cod pot study conducted in Kupreanof Strait, Alaska.

Sequential Pot No.	Quad No.	Pot Type	Depth (fm)	Soak Time (hours)	Date		Gear Location				No. of Pacific Cod	No. of Tanner Crabs
							N. Latitude		W. Longitude			
					Gear Set	Gear Pick	Degrees	Minutes	Degrees	Minutes		
1	1	2	54	15.1	3/11/98	3/12/98	57	59.20	153	5.25	34	0
2	1	1	54	15.1	3/11/98	3/12/98	57	59.09	153	5.25	21	0
3	1	3	51	15.2	3/11/98	3/12/98	57	59.09	153	5.48	15	0
4	1	4	54	15.2	3/11/98	3/12/98	57	59.21	153	5.47	0	0
5	2	4	51	15.5	3/11/98	3/12/98	57	59.79	153	6.52	0	0
6	2	2	53	15.6	3/11/98	3/12/98	57	59.70	153	6.52	38	0
7	2	1	53	15.6	3/11/98	3/12/98	57	59.70	153	6.70	22	0
8	2	3	52	15.6	3/11/98	3/12/98	57	59.79	153	6.69	10	0
9	3	2	54	15.9	3/11/98	3/12/98	58	0.63	153	8.42	10	0
10	3	4	54	16.0	3/11/98	3/12/98	58	0.53	153	8.42	0	0
11	3	1	55	16.0	3/11/98	3/12/98	58	0.53	153	8.64	16	0
12	3	3	55	16.0	3/11/98	3/12/98	58	0.53	153	8.63	9	0
13	4	4	56	16.3	3/11/98	3/12/98	58	0.15	153	13.38	0	0
14	4	3	57	16.3	3/11/98	3/12/98	58	0.06	153	13.39	17	0
15	4	2	55	16.3	3/11/98	3/12/98	58	0.05	153	13.60	21	0
16	4	1	63	16.4	3/11/98	3/12/98	58	0.15	153	13.60	23	0
17	5	4	49	6.1	3/12/98	3/12/98	57	59.24	153	5.57	0	0
18	5	3	52	6.2	3/12/98	3/12/98	57	59.24	153	5.37	13	0
19	5	1	53	6.3	3/12/98	3/12/98	57	59.11	153	5.37	25	0
20	5	2	48	6.4	3/12/98	3/12/98	57	59.10	153	5.57	24	0
21	6	3	51	6.0	3/12/98	3/12/98	57	59.81	153	6.54	1	0
22	6	1	52	6.1	3/12/98	3/12/98	57	59.74	153	6.54	21	0
23	6	4	52	6.1	3/12/98	3/12/98	57	59.74	153	6.69	0	0
24	6	2	51	6.2	3/12/98	3/12/98	57	59.82	153	6.68	19	0
25	7	3	48	5.8	3/12/98	3/12/98	58	0.42	153	8.23	34	0
26	7	1	52	5.8	3/12/98	3/12/98	58	0.42	153	8.03	10	0
27	7	4	57	5.9	3/12/98	3/12/98	58	0.31	153	8.03	1	0
28	7	2	49	6.0	3/12/98	3/12/98	58	0.31	153	8.26	24	0
29	8	1	51	5.6	3/12/98	3/12/98	58	0.00	153	13.62	12	0
30	8	3	61	5.7	3/12/98	3/12/98	58	0.12	153	13.62	24	0
31	8	2	62	5.7	3/12/98	3/12/98	58	0.12	153	13.44	25	0
32	8	4	54	5.8	3/12/98	3/12/98	58	0.01	153	13.43	0	0
33	9	4	53	17.2	3/12/98	3/13/98	57	59.21	153	5.53	1	0
34	9	3	55	17.2	3/12/98	3/13/98	57	59.21	153	5.29	13	0
35	9	1	54	17.2	3/12/98	3/13/98	57	59.09	153	5.29	15	0
36	9	2	52	17.2	3/12/98	3/13/98	57	59.09	153	5.53	29	0
37	10	3	51	17.4	3/12/98	3/13/98	57	59.80	153	6.52	20	0
38	10	1	54	17.4	3/12/98	3/13/98	57	59.69	153	6.52	28	0
39	10	4	51	17.4	3/12/98	3/13/98	57	59.69	153	6.70	0	0
40	10	2	52	17.4	3/12/98	3/13/98	57	59.79	153	6.70	27	0
41	11	3	50	17.6	3/12/98	3/13/98	58	0.42	153	8.18	18	0
42	11	1	51	17.6	3/12/98	3/13/98	58	0.42	153	7.94	23	0

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Appendix A. (page 2 of 4)

Sequential Pot No.	Quad No.	Pot Type	Depth (fm)	Soak Time (hours)	Date		Gear Location				No. of Pacific Cod	No. of Tanner Crabs
							N. Latitude		W. Longitude			
					Gear Set	Gear Pick	Degrees	Minutes	Degrees	Minutes		
43	11	4	58	17.6	3/12/98	3/13/98	58	0.27	153	7.94	0	0
44	11	2	56	17.6	3/12/98	3/13/98	58	0.27	153	8.18	29	0
45	12	4	51	17.1	3/12/98	3/13/98	57	58.77	153	6.46	1	0
46	12	1	56	17.2	3/12/98	3/13/98	57	58.77	153	6.68	35	1
47	12	3	59	17.3	3/12/98	3/13/98	57	58.85	153	6.68	20	0
48	12	2	56	16.8	3/12/98	3/13/98	57	58.85	153	6.45	36	0
49	13	2	51	6.4	3/13/98	3/13/98	57	59.21	153	5.70	25	0
50	13	1	49	6.4	3/13/98	3/13/98	57	59.20	153	5.57	18	0
51	13	4	48	6.5	3/13/98	3/13/98	57	59.11	153	5.57	1	0
52	13	3	55	6.6	3/13/98	3/13/98	57	59.13	153	5.77	12	0
53	14	2	49	6.1	3/13/98	3/13/98	57	59.82	153	6.77	26	0
54	14	3	51	6.2	3/13/98	3/13/98	57	59.82	153	6.57	14	0
55	14	4	52	6.3	3/13/98	3/13/98	57	59.72	153	6.57	0	0
56	14	1	49	6.3	3/13/98	3/13/98	57	59.72	153	6.77	13	0
57	15	2	48	5.9	3/13/98	3/13/98	58	0.41	153	7.92	7	0
58	15	4	57	6.0	3/13/98	3/13/98	58	0.30	153	7.92	0	0
59	15	1	48	6.0	3/13/98	3/13/98	58	0.30	153	8.22	13	0
60	15	3	49	6.1	3/13/98	3/13/98	58	0.41	153	8.22	16	0
61	16	3	49	5.7	3/13/98	3/13/98	57	58.76	153	6.45	17	0
62	16	1	53	5.8	3/13/98	3/13/98	57	58.76	153	6.67	32	0
63	16	2	59	5.8	3/13/98	3/13/98	57	58.88	153	6.66	32	0
64	16	4	58	5.9	3/13/98	3/13/98	57	58.88	153	6.45	0	0
65	17	2	53	17.0	3/13/98	3/14/98	57	59.20	153	5.71	12	0
66	17	1	55	17.0	3/13/98	3/14/98	57	59.20	153	5.50	12	0
67	17	4	53	17.0	3/13/98	3/14/98	57	0.08	153	5.50	0	0
68	17	3	60	17.0	3/13/98	3/14/98	57	0.08	153	5.72	16	0
69	18	2	49	17.2	3/13/98	3/14/98	57	59.82	153	6.78	24	0
70	18	3	49	17.2	3/13/98	3/14/98	57	59.82	153	6.48	4	0
71	18	4	54	17.2	3/13/98	3/14/98	57	59.67	153	6.48	0	0
72	18	1	48	17.2	3/13/98	3/14/98	57	59.66	153	6.78	7	0
73	19	2	49	17.5	3/13/98	3/14/98	58	0.39	153	7.78	10	0
74	19	4	55	17.5	3/13/98	3/14/98	58	0.27	153	7.78	2	0
75	19	1	57	17.5	3/13/98	3/14/98	58	0.27	153	8.12	4	0
76	19	3	53	17.4	3/13/98	3/14/98	58	0.39	153	8.11	7	0
77	20	3	50	17.8	3/13/98	3/14/98	57	58.77	153	6.42	17	1
78	20	1	54	17.8	3/13/98	3/14/98	57	58.77	153	6.61	15	0
79	20	2	61	17.8	3/13/98	3/14/98	57	58.87	153	6.61	21	0
80	20	4	58	17.7	3/13/98	3/14/98	57	58.88	153	6.42	0	0
81	21	3	55	6.7	3/14/98	3/14/98	57	59.09	153	5.25	12	0
82	21	1	50	6.8	3/14/98	3/14/98	57	59.09	153	5.47	10	0
83	21	2	52	6.8	3/14/98	3/14/98	57	59.21	153	5.47	17	0
84	21	4	52	6.9	3/14/98	3/14/98	57	59.21	153	5.25	0	0
85	22	1	52	6.5	3/14/98	3/14/98	57	59.73	153	7.66	21	0
86	22	2	51	6.6	3/14/98	3/14/98	57	59.86	153	7.64	17	0
87	22	3	49	6.6	3/14/98	3/14/98	57	59.86	153	7.45	6	0

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Appendix A. (page 3 of 4)

Sequential Pot No.	Quad No.	Pot Type	Depth (fm)	Soak Time (hours)	Date		Gear Location				No. of Pacific Cod	No. of Tanner Crabs
							N. Latitude		W. Longitude			
					Gear Set	Gear Pick	Degrees	Minutes	Degrees	Minutes		
88	22	4	57	6.7	3/14/98	3/14/98	57	59.73	153	7.46	0	0
89	23	3	49	6.3	3/14/98	3/14/98	58	0.91	153	9.30	4	0
90	23	2	52	6.5	3/14/98	3/14/98	58	0.77	153	9.30	5	0
91	23	1	51	6.5	3/14/98	3/14/98	58	0.77	153	9.51	9	0
92	23	4	45	6.6	3/14/98	3/14/98	58	0.91	153	9.53	0	0
93	24	4	55	6.2	3/14/98	3/14/98	57	58.80	153	6.78	0	0
94	24	2	59	6.3	3/14/98	3/14/98	57	58.92	153	6.77	16	0
95	24	1	59	6.4	3/14/98	3/14/98	57	58.92	153	6.58	10	0
96	24	3	56	6.4	3/14/98	3/14/98	57	58.80	153	6.57	9	0
97	25	3	51	16.7	3/14/98	3/15/98	57	58.98	153	5.26	13	0
98	25	1	62	16.6	3/14/98	3/15/98	57	58.98	153	5.47	10	0
99	25	2	54	16.6	3/14/98	3/15/98	57	59.08	153	5.46	9	0
100	25	4	53	16.5	3/14/98	3/15/98	57	59.09	153	5.26	0	0
101	26	1	54	16.7	3/14/98	3/15/98	57	59.68	153	7.60	29	0
102	26	2	52	16.8	3/14/98	3/15/98	57	59.86	153	7.60	15	0
103	26	3	59	16.7	3/14/98	3/15/98	57	59.86	153	7.30	5	0
104	26	4	61	16.7	3/14/98	3/15/98	57	59.67	153	7.29	0	0
105	27	3	51	16.8	3/14/98	3/15/98	58	0.87	153	9.28	9	0
106	27	2	49	16.8	3/14/98	3/15/98	58	0.70	153	9.28	20	0
107	27	1	58	16.8	3/14/98	3/15/98	58	0.70	153	9.54	12	0
108	27	4	51	16.8	3/14/98	3/15/98	58	0.87	153	9.54	0	0
109	28	4	59	16.9	3/14/98	3/15/98	57	58.79	153	6.80	0	0
110	28	2	58	16.9	3/14/98	3/15/98	57	58.89	153	6.80	12	0
111	28	1	62	16.9	3/14/98	3/15/98	57	58.88	153	6.60	9	1
112	28	3	57	16.9	3/14/98	3/15/98	57	58.80	153	6.61	5	0
113	29	4	50	76.8	3/15/98	3/18/98	57	59.47	153	6.22	3	0
114	29	2	54	76.8	3/15/98	3/18/98	57	59.34	153	6.22	26	0
115	29	1	56	76.8	3/15/98	3/18/98	57	59.34	153	6.46	19	0
116	29	3	53	76.8	3/15/98	3/18/98	57	59.47	153	6.48	6	0
117	30	4	57	76.8	3/15/98	3/18/98	57	59.66	153	7.46	1	0
118	30	1	52	76.8	3/15/98	3/18/98	57	59.79	153	7.46	38	0
119	30	3	49	76.8	3/15/98	3/18/98	57	59.78	153	7.26	2	0
120	30	2	59	76.8	3/15/98	3/18/98	57	59.66	153	7.27	18	0
121	31	4	58	76.8	3/15/98	3/18/98	58	0.63	153	9.66	2	0
122	31	1	54	76.8	3/15/98	3/18/98	58	0.73	153	9.66	14	1
123	31	3	52	76.8	3/15/98	3/18/98	58	0.73	153	9.45	4	0
124	31	2	53	76.8	3/15/98	3/18/98	58	0.63	153	9.45	16	0
125	32	3	54	76.8	3/15/98	3/18/98	57	58.42	153	5.44	17	0
126	32	1	49	76.8	3/15/98	3/18/98	57	58.42	153	5.66	18	0
127	32	2	58	76.8	3/15/98	3/18/98	57	58.50	153	5.66	40	0
128	32	4	56	76.8	3/15/98	3/18/98	57	58.51	153	5.44	0	0
129	33	3	51	18.2	3/18/98	3/19/98	57	59.51	153	6.20	12	0
130	33	1	52	18.2	3/18/98	3/19/98	57	59.39	153	6.19	10	0
131	33	4	57	18.3	3/18/98	3/19/98	57	59.40	153	6.45	0	0
132	33	2	52	18.3	3/18/98	3/19/98	57	59.53	153	6.46	14	0

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Appendix A. (page 4 of 4)

Sequential Pot No.	Quad No.	Pot Type	Depth (fm)	Soak Time (hours)	Date		Gear Location				No. of Pacific Cod	No. of Tanner Crabs
							N. Latitude		W. Longitude			
					Gear Set	Gear Pick	Degrees	Minutes	Degrees	Minutes		
133	34	2	48	18.1	3/18/98	3/19/98	57	59.86	153	7.52	23	0
134	34	3	49	18.1	3/18/98	3/19/98	57	59.87	153	7.26	2	0
135	34	4	50	18.1	3/18/98	3/19/98	57	59.78	153	7.25	0	0
136	34	1	53	18.2	3/18/98	3/19/98	57	59.77	153	7.54	22	0
137	35	2	49	18.2	3/18/98	3/19/98	58	0.80	153	9.95	12	0
138	35	1	51	18.3	3/18/98	3/19/98	58	0.80	153	9.71	17	0
139	35	4	60	18.3	3/18/98	3/19/98	58	0.65	153	9.71	0	0
140	35	3	67	18.3	3/18/98	3/19/98	58	0.65	153	9.96	1	0
141	36	4	55	18.3	3/18/98	3/19/98	57	58.37	153	5.41	1	0
142	36	2	49	18.3	3/18/98	3/19/98	57	58.37	153	5.59	13	0
143	36	1	59	18.3	3/18/98	3/19/98	57	58.49	153	5.59	5	0
144	36	3	59	18.4	3/18/98	3/19/98	57	58.47	153	5.40	6	0
145	37	2	54	7.0	3/19/98	3/19/98	57	59.58	153	6.72	8	0
146	37	3	53	7.0	3/19/98	3/19/98	57	59.68	153	6.72	9	0
147	37	1	52	7.1	3/19/98	3/19/98	57	59.68	153	6.46	9	0
148	37	4	48	7.1	3/19/98	3/19/98	57	59.57	153	6.46	15	0
149	38	1	51	6.7	3/19/98	3/19/98	58	0.29	153	8.43	6	0
150	38	3	46	6.7	3/19/98	3/19/98	58	0.30	153	8.20	3	0
151	38	4	49	6.7	3/19/98	3/19/98	58	0.12	153	8.17	0	0
152	38	2	48	6.8	3/19/98	3/19/98	58	0.13	153	8.42	13	0
153	39	3	61	6.3	3/19/98	3/19/98	58	0.66	153	10.59	11	0
154	39	4	54	6.3	3/19/98	3/19/98	58	0.81	153	10.58	0	0
155	39	2	49	6.4	3/19/98	3/19/98	58	0.82	153	10.30	15	0
156	39	1	60	6.4	3/19/98	3/19/98	58	0.66	153	10.37	19	0
157	40	3	59	6.0	3/19/98	3/19/98	57	58.53	153	5.23	8	0
158	40	4	57	6.1	3/19/98	3/19/98	57	58.42	153	5.21	0	0
159	40	1	55	6.2	3/19/98	3/19/98	57	58.43	153	5.50	18	0
160	40	2	61	6.3	3/19/98	3/19/98	57	58.56	153	5.61	7	0
161	41	2	54	16.7	3/19/98	3/20/98	57	59.58	153	6.73	10	0
162	41	3	53	16.7	3/19/98	3/20/98	57	59.68	153	6.72	2	0
163	41	1	52	16.7	3/19/98	3/20/98	57	59.68	153	6.46	14	0
164	41	4	48	16.6	3/19/98	3/20/98	57	59.57	153	6.46	0	0
165	42	1	51	16.6	3/19/98	3/20/98	58	0.29	153	8.43	8	0
166	42	3	46	16.6	3/19/98	3/20/98	58	0.30	153	8.20	3	0
167	42	4	49	16.6	3/19/98	3/20/98	58	0.12	153	8.17	1	0
168	42	2	48	16.7	3/19/98	3/20/98	58	0.13	153	8.42	2	0
169	43	3	61	16.6	3/19/98	3/20/98	58	0.66	153	10.59	13	0
170	43	4	54	16.6	3/19/98	3/20/98	58	0.81	153	10.58	0	0
171	43	2	49	16.6	3/19/98	3/20/98	58	0.82	153	10.30	4	0
172	43	1	60	16.6	3/19/98	3/20/98	58	0.66	153	10.37	5	0
173	44	3	59	16.5	3/19/98	3/20/98	57	58.53	153	5.23	16	0
174	44	4	57	16.5	3/19/98	3/20/98	57	58.42	153	5.21	0	0
175	44	1	55	16.5	3/19/98	3/20/98	57	58.43	153	5.50	3	0
176	44	2	61	16.5	3/19/98	3/20/98	57	58.56	153	5.61	6	0