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Distribution, Abundance, Quality, and Production Fishing Studies on the Surf Clam, *Spisula polynyma*, in the Southeastern Bering Sea, 1978

May 1979

NOTICE

DISTRIBUTION, ABUNDANCE, QUALITY, AND PRODUCTION FISHING STUDIES ON THE SURF CLAM, *Spisula polynyma*, IN THE SOUTHEASTERN BERING SEA, 1978

by

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and

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A Cooperative Industry-Federal-State of Alaska Study

Sponsored By:

New England Fish Company
Snow Food Products, Borden, Inc.
Campbell Soup Company
Gorton Division, General Mills
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Pacific Seapro
Dutch Harbor Seafoods
National Marine Fisheries Service
Alaska Department of Fish and Game
Alaska Department of Commerce
North Pacific Fishery Management Council

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U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northwest and Alaska Fisheries Center
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INTRODUCTION

A second season of field research aimed at assessing the potentials of a surf clam fishery in the southeastern Bering Sea was concluded in August 1978. Following the 1977 survey (Hughes et al., 1977 and Hughes et al., 1978) which resulted in delineation of a resource estimated at over 286,000 metric tons of harvestable whole clams near the Alaska Peninsula (Fig. 1), efforts in 1978 emphasized production fishing and environmental impact studies. Additional aspects of the overall study initiated in 1977 and continued in 1978 included a second resource-assessment survey, analyses for paralytic shellfish poison (PSP), collection of biological data required for resource management decisions, and expanded studies to determine processing and product quality.

Production fishing studies using a commercial-size, hydraulic clam harvester were emphasized in 1978 to determine if the resource discovered in 1977 occurred in concentrations sufficiently dense to support a viable fishery. The commercial-scale clam removals also afforded an opportunity to access ecological changes to the environment resulting from the fishing effort. Ecological studies were conducted under private contract for the North Pacific Fishery Management Council to provide data for the development of an environmental impact statement. While results of that study will be summarized here, this report deals primarily with production fishing studies, tests for PSP, resource distribution, biomass, size composition, and a financial feasibility study of a surf clam fishery in the SE Bering Sea.

As in 1977, financial support for and participation in the 1978 surf clam research involved private industry and both Federal and State of Alaska agencies. Over $80,000 was contributed by eight fishing/processing

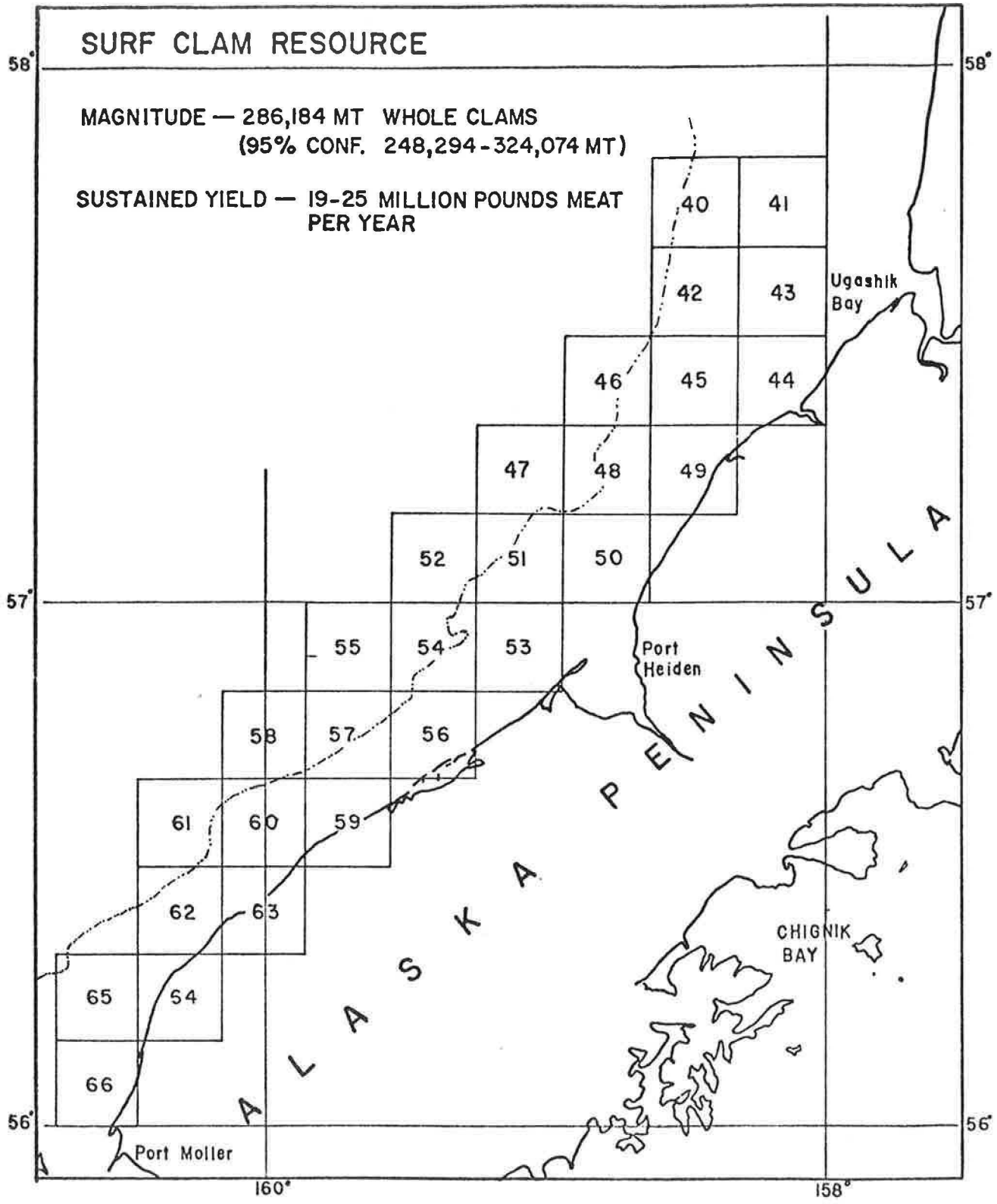

Fig. 1.--Location of survey blocks 40-65 along the Bering Sea side of the Alaska Peninsula where an estimated 286,000 metric ton (mt), surf clam resource was identified during the 1977 joint Industry-Government clam survey.

companies: New England Fish Co., Seattle; Peter Pan Seafoods, Seattle; Snow Foods Division of Borden, Inc., Columbus, OH; Gorton Division of General Mills, Gloucester, MA; Campbell Soup Company, Camden, JN; Guilford Packing Co., Inc., Port Townsend, WA; Pacific Seapro, Tacoma, WA; and Dutch Harbor Seafoods, Redmond, WA. The State of Alaska Economic Development Division contributed $60,000. Alaska Department of Fish and Game served as administrator of research funds and provided scientific personnel during the field work. The North Pacific Fishery Management Council provided $20,000 in addition to supporting a $107,000 contract for the ecological studies; the National Marine Fisheries Service (NMFS) provided $80,000, scientific leadership for the research venture, analytical facilities and personnel for PSP analysis, and the use of the NOAA research vessel for conducting ecological studies.

VESSELS AND GEAR

Operations were conducted from the 102-ft trawler-crabber Sea Hawk as the clam survey vessel, and the 100-ft NOAA research vessel Oregon, which served as the base for most ecological studies.

The Sea Hawk was powered by two V.12.71 GM[1/] diesels, each producing 330 hp at 1800 rpm. Electronic fishing and navigation aids included dual radars, loran C with a loran C plotter, automatic pilot, echosounders, and radios. The vessel was equipped with both freezer and live-tank holds. Fishing gear consisted of an East Coast style commercial hydraulic clam harvester with a 72-in (fishing width) knife. A concave steel guard, designed to divert crab and other epibenthic organisms from the harvester's

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1/ Reference to trade name does not imply endorsement by the National Marine Fisheries Service, NOAA.

path, was constructed on the forward section of the gear. A deck mounted, engine-pump package supplied water to the harvester's manifold. This unit consisted of a 4,000 gpm Deming pump with a 20-in impeller driven by a 6-cylinder, Allis Chalmers model 25000, Mark II, turbo charged diesel, delivering 360 hp at 1,800 rpm. The on-deck water supply was carried to the harvester via a 6-inch-diameter rubber hose rated at 150 psi. The 5,500-pound harvester was set and retrieved from the port side by a trawl winch and boom system and towed with 3-in. diameter polypropylene line.

The vessel was captained by her owner, John Roberts, a veteran East Coast surf clam skipper who recently relocated to the West Coast. Captain Roberts and his experienced clamming crew made numerous gear adjustments during production fishing trials in an attempt to "tune the gear" to various fishing conditions encountered.

The Oregon was stationed on and near three sites where the Sea Hawk conducted production clam-harvesting trials. Gear deployed to determine epibenthic and inbenthic fauna and ecological conditions (before and after clam harvesting) included an underwater TV system, a VanVeen grab capable of obtaining a 1/10-m^2 substrate sample to a depth of 10 in, and a small trawl.

METHODS

SURVEY DESIGN

A major portion of the survey effort was devoted to a series of intensive production fishing-ecological studies in blocks 57 and 59. Within these adjacent blocks (Fig. 1), three 1/2-x-1/4-nmi plots and a

control site were marked with buoys.

Grab sampling of substrate in the three plots and the control site was done prior to, during, and after harvesting to provide baseline information on benthic species composition, population densities, and sediment profiles to provide the basis for determining changes as a result of harvesting. An underwater TV system was employed to position the VanVeen grab within the clam-harvester tracks immediately after fishing; epibenthic organisms were collected by trawl to identify stomach contents of predators.

Surf clam harvesting in the three 1/2-x-1/4-nmi plots was conducted at high, medium, and low fishing densities, respectively, to investigate the degree of ecological change resulting from these different fishing efforts.

Further studies of production fishing were conducted in 10 other locations along the Alaska Peninsula. These locations, like the three production fishing ecological study sites, were discovered through exploratory fishing and results of the 1977 survey. When apparent commercial clam concentrations were encountered, a marker buoy was set and at least 10 tows completed to establish catch rates. Harvesting was conducted as it would be during a commercial fishery. Tow durations ranged from 10 to 30 minutes but were usually 10-15 minutes.

During the 1978 operations, a second resource assessment survey was conducted to provide a check on surf clam biomass estimates obtained during the initial 1977 survey and to strengthen the data base for final biomass estimates. As in 1977, resource assessment tows were completed at random within survey blocks, and an area swept technique was used to

calculate surf clam biomass from resulting catch data.

Clams obtained daily were sampled and retained for analysis of PSP; however, two separate extensive collections for PSP samples from the entire resource area were completed. These collections were made on the first 3 and the last 3 days of the 4 July-10 August cruise period and consisted of representative clams from one tow within each sampling block along the Peninsula.

COLLECTION OF BIOLOGICAL DATA

Clams from each catch were sorted by species and weighed to determine species composition and catch rates. Crab were also carefully enumerated; however, other minor invertebrate catch components were not as carefully enumerated as during the 1977 survey. At each production fishing site, surf clam catches were subsampled from representative tows and size composition determined by measuring shell length of 200-300 individuals. Other clam species were measured as time permitted.

Two stratified samples of surf clams (25 individuals per 5-mm length interval) were collected to determine length at age relationships for later development of age-length keys, age composition, growth, and mortality studies. Clams exceeding 70 mm in length were shucked and the shells frozen for annual ring counts, while those measuring less than 70 mm were frozen whole.

Surf clams were also preserved for later studies to determine size at maturity and reproductive activity.

COLLECTION OF SAMPLES FOR PSP DETERMINATION

Clams were frozen at sea for later use in analysis for PSP. During

each day of production fishing, samples for PSP analysis were taken from at least seven tows. Each sample consisted of all clam species represented. For the larger species (surf clams and cockles), 12 individuals were shucked, the meat frozen, and identified by code number. For the smaller species (tellins and Macoma spp.), 20-25 individuals were frozen whole. Samples obtained during the extensive PSP surveys at the beginning and end of the cruise period were handled in an identical manner.

All PSP samples collected were analyzed by NMFS for PSP by the mouse bioassay method. In the laboratory, clams were thawed, shucked when necessary, then separated into edible portion and viscera. Edible portions and viscera were analyzed separately. If a test for PSP were positive, it was repeated.

SAMPLES FOR PRODUCT EVALUATION STUDIES

Whole surf clams were packed in 80- to 120-pound-capacity burlap bags and frozen aboard the Sea Hawk. Shucked surf clam meats were also frozen aboard ship in 5-pound boxes. All frozen samples were identified by codes corresponding to the PSP sample codes and shipped to Seattle for distribution to industry participants for quality studies.

RESULTS

Clamming operations conducted by the Sea Hawk were effective. Vessel and gear worked well, and no breakdowns or gear damage were experienced. A total of 488 tows with the clam harvester were completed; over 60,000 pounds of whole surf clams, 1,100 pounds of tellins, and 3,100 pounds of surf-clam meat were frozen aboard ship and freighted to Seattle. All

biological data requirements were completed, and 371 clam samples for PSP analysis were collected and returned to the Seattle Laboratory of the Northwest and Alaska Fisheries Center.

Ecological studies were conducted primarily from the Oregon but completed by the Sea Hawk as planned. Problems were encountered with the underwater TV system and attempts to visually locate the VanVeen grab directly into clam harvester tracks met with limited success. However, the 1/10-m^2 VanVeen grab proved to be an excellent sampling tool, and all other aspects of the contracted ecological studies went well.

FISHING CONDITIONS

In addition to general weather conditions, both current velocity and substrate conditions affected fishing success in the Bering Sea survey area.

Current velocity averaged about 1.5 knots and often exceeded 2 knots, which was considerably greater than currents over the clam grounds fished in the Atlantic. The strong current velocities affected the ability of the vessel to maintain tow direction and desired tow speed; the velocities significantly reduced catch rates during peak tidal flow relative to slack water periods.

The black sand substrate in blocks 54-65 (Fig. 1) was generally good for fishing. Substrates in blocks 40-53 were varied: streaks of black sand, gravel, peat, and rocky areas. This made fishing more difficult, increased scouting time to locate clam concentrations, and reduced catch rates.

PRODUCTION FISHING STUDIES

Thirteen production sites in the survey area were located and fished to establish catch rates applicable to evaluating the feasibility of a commercial fishery. During this portion of the survey, 52.14 hours of actual fishing time with the 6-ft wide clam harvester resulted in a catch of 87,750 pounds of surf clams.

The location of these production sites within the survey area is shown in Figure 2 with associated catch data from each site given in Table 1. Environmental impact studies were conducted at production sites 4, 6, and 10.

Data presented indicate the overall surf clam catch rate with the 6-ft wide harvester was 1,683 lb or 21 bushels per hour (at 80 pounds per bushel). Catch rates at production sites 1-3 were considerably lower (11.3-18.6 bu/h) than other sites due to variable and hard substrates encountered in survey blocks 44, 45, and 50. At production site 10 in block 59, harder than average substrate was encountered and lower production rates were experienced. In such hard substrate areas, catch rates dropped considerably if tows exceeded 15-min durations. For example, while the site 10 production rate was 17.5 bu/h, tows of less than 15-min duration produced a catch rate of 31.5 bu/h. In areas of normal black-sand substrate, tows of less than 15-min duration produced essentially the same catch rates as those produced in tows of 15- to 30-min duration.

During production fishing trials, few "clean" catches of surf clams were obtained. Most areas produced high incidental catches of starfish and old surf clam shells, indicating that automated catch sorting deck

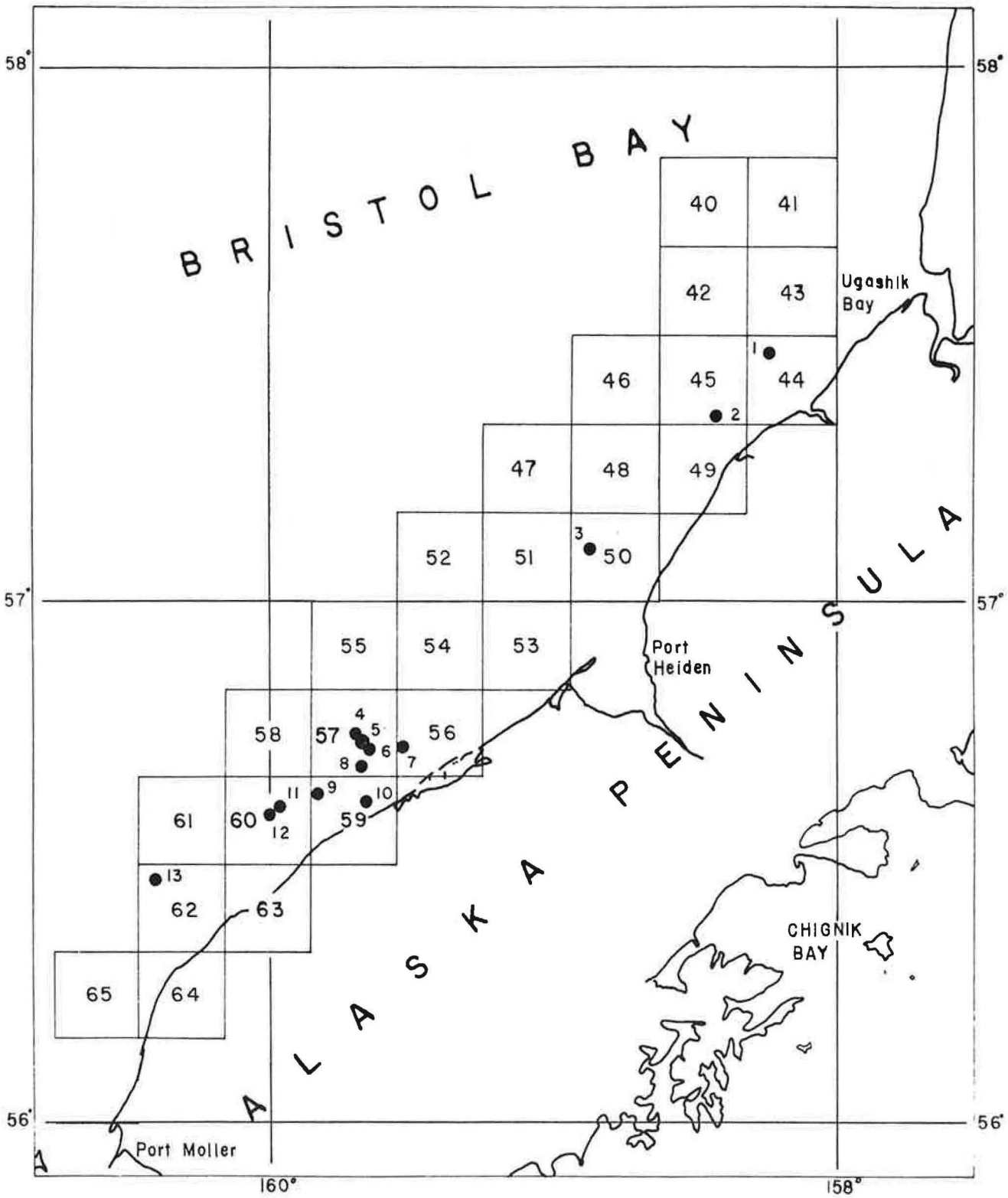

Figure 2. Location of 13 sites in the Alaska Peninsula survey area (blocks 40-65) where production-fishing studies on Alaskan surf clams were completed.

Table 1. Surf clam catch information obtained with a 6-ft wide hydraulic clam harvester at 13 production fishing sites along the Alaska peninsula survey area in the SE Bering Sea.

Production site no.	Survey block no.	Fishing effort (h)	Total catch (1b)	Catch/Hour		Average clam length	
				lb	bu	in	mm
1	44	1.67	1,511	907	11.3	4.5	115
2	45	1.40	1,882	1,344	16.8	4.5	115
3	50	2.47	3,669	1,487	18.6	3.9	98
4	57	11.08	17,820	1,608	20.1	3.9	99
5	57	2.60	5,118	1,968	24.6	4.1	103
6	57	9.15	16,120	1,762	22.0	4.3	110
7	56	1.83	3,503	1,911	23.9	4.1	103
8	57	1.67	4,740	2,844	35.5	4.3	109
9	59	1.50	3,033	2,022	25.3	4.5	115
10	59	13.05	18,237	1,397	17.5	4.0	101
11	60	1.02	1,595	1,569	19.6	4.4	111
12	60	2.53	5,054	1,995	24.9	4.5	114
13	62	2.17	5,468	2,524	31.9	3.9	99
All sites		52.14	87,750	1,683	21.0		

gear would be essential in a Bering Sea surf clam fishery. As an example, a typical 15-min tow would produce 400-600 pounds of surf clams, 100-200 pounds of starfish, and 100 pounds of old surf clam shells. The second, most abundant clam species obtained was the Alaska tellin, which normally did not exceed 20-30 pounds on a typical catch. Cockles, Macoma spp. of clams, and razor clams were obtained in quantities normally not exceeding 5 pounds per species per tow in most areas.

King crab were rare in catches, and no tanner crab were taken.

SURF CLAM BIOMASS ESTIMATES

During the 1978 survey, 234 resource assessment tows were completed for purposes of obtaining a check on initial surf clam resource magnitude estimates (exploitable biomass). Initial estimates obtained in 1977 were based upon 132 resource assessment tows.

Table 2 summarizes the estimated metric tons of harvestable surf clams in the resource area by survey blocks as a result of the 1977 survey,the 1978 survey, and the 1977 and 1978 combined survey data. Results of the 1977 survey indicated a biomass range (95% confidence) of 248,000-324,000 metric tons (mt) of surf clams. The 1978 survey indicated 303,000-376,000 mt (95% confidence), and the combined 1977-1978 data indicated a biomass range (95% confidence) of 277,000-381,000 mt of surf clams. It was expected that the 1978 biomass estimate would be higher than in 1977 because the 2-in diameter rings used in the 1978 gear allowed capture of smaller clams and, hence, the harvestable size range

Table 2.--Estimated exploitable surf clam biomass by sampling block along the Alaska Peninsula--1977, 1978, and 1977-1978 data combined.

Block no.	Area square miles	1977 No. of tows	1977 Biomass estimate (metric tons)	1978 No. of tows	1978 Biomass estimate (metric tons)	1977-78 Data Combined No. of tows	1977-78 Data Combined Biomass estimate (metric tons)
40	100	1	2,703	0	--	1	2,703
42	100	2	1,757	5	19,705	7	14,493
43	100	0	--	10	22,132	10	22,132
44	60	0	--	14	15,028	14	15,028
45	100	22	58,279	21	31,993	43	40,476
46	100	3	6,249	0	--	3	6,249
48	100	9	11,037	4	3,878	13	7,562
49	77	4	8,792	6	6,099	10	6,595
50	97	10	53,530	31	32,996	41	35,867
51	100	2	27	5	18,563	7	13,266
54	100	2	1,409	0	--	2	1,409
55	100	1	378	0	--	1	378
56	70	0	N.D.	17	15,276	17	15,276
57	100	15	18,361[1/]	47	57,857	61	48,091[1/]
58	100(20)[1/]	1	23,114[1/]	0	--	1	4,623[1/]
59	54	7	16,026	22	30,508	29	26,368
60	96	21	31,194[1/]	38	44,429	59	37,879[1/]
61	100(20)[1/]	12	33,255[1/]	0	0	12	5,543[1/]
62	86	18	19,803	14	35,856	32	24,971
65	100	2	270	0	--	2	270
T	2,038	132	286,184	234	334,320	365	329,179
Biomass range at 95% Confidence level		248,294 - 324,074		302,574 - 376,093		277,172 - 381,186	

[1/] The fishable area in blocks 58 and 61 was overestimated in the 1977 survey. Soundings in these blocks in 1978 indicated each block contained only about 20 square miles of fishable sea bed. Combined 1977-78 biomass figures reflect this change.

was increased.

It should also be noted that while most survey blocks were assessed each year, the total area covered during each year's survey are not directly comparable. However, the combined 1977-1978 data does provide coverage of the 2,000 square miles which the resource occupies. Blocks not surveyed (41, 42, 52, 53, 63, 64) were generally found unfishable due to hard sea bed conditions or excessive depth.

BIOLOGICAL DATA

Two extensive samples of surf clams were collected for analysis of age composition, age-length relationships, growth studies, and mortality studies. Additional samples were collected to determine state of reproductive activity and size and age at first maturity. Analysis of the above samples have not been completed to date.

RESULTS OF PSP ANALYSIS

Between 4 July and 8 August, 1978, 371 clams samples were collected to determine the incidence of PSP in the 2,000-square mile, resource study area. Collected were: 185 surf clam, Spisula polynyma, 133 tellin clam, Tellina lutea, and 53 miscellaneous clam samples representing 19 blocks.

In the laboratory, the edible portion of the clam was separated from the viscera. These two portions were analyzed separately for PSP using the Association of Official Analytical Chemists standard mouse bioassay procedure. The results of all analyses are presented in Tables 3-8.

Surf Clam Results.--Toxic edible portion samples were found from blocks 50 and 51. The average levels of PSP in each of these samples were 39 µg/100 g and 53 µg/100 g, both well below the 80 µg PSP/100 g meat limit set by

Table 3. Paralytic shellfish poison (PSP) results - *Spisula polynyma*

Block no.	Meats only			Viscera		
	No. of samples	No. positive	Range of means (ug PSP/100 g)	No. of samples	No. positive	Range of means (ug PSP/100 g)
40	2	0	--	2	0	--
41	2	0	--	2	0	--
42	4	0	--	4	0	--
43	6	0	--	6	0	--
44	10	0	--	10	0	--
45	11	0	--	11	0	--
46	2	0	--	2	1	49
48	4	0	--	4	0	--
49	2	0	--	2	0	--
50	14	1	39	14	11	39-271
51	2	1	53	2	1	234
54	1	0	--	1	1	137
56	13	0	--	13	1	48
57	54	2	56-69	54	6	28- 53
59	25	0	--	25	10	29- 67
60	19	0	--	19	3	44- 56
62	10	0	--	10	0	--
63	2	0	--	2	1	51
65	2	0	--	2	0	--
	T 185	4		185	35	

Table 4. Paralytic shellfish poison (PSP) results - Tellina lutea

Block no.	Meats only			Viscera		
	No. of samples	No. positive	Range of means (µg PSP/100 g)	No. of samples	No. positive	Range or means (µg PSP/100 g)
40	2	0	--	2	1	43
41	2	0	--	2	0	--
42	4	0	--	4	4	38- 52
43	6	0	--	6	1	43
44	9	0	--	9	1	28
45	11	0	--	11	10	28- 62
46	2	1	35	2	2	39-130
48	4	0	--	4	4	38- 69
49	3	0	--	3	3	29- 80
50	12	5	27-47	12	12	59-310
51	2	2	56-65	2	2	81-400
53	1	1	43	1	1	109
54	1	0	--	1	1	289
56	8	0	--	8	8	50- 97
57	42	1	65	42	40	42-149
59	13	1	65	13	13	53-223
60	9	1	33	9	9	42-119
62	1	0	--	1	1	42
65	1	0	--	1	1	44
	T 133	12		133	113	

Table 5. Paralytic shellfish poison (PSP) results - Macoma spp.

Block no.	Meats only			Viscera		
	No. of samples	No. positive	Range of means (µg PSP/100 g)	No. of samples	No. positive	Range of means (µg PSP/100 g)
44	4	1	44	4	4	45-77
45	1	1	37	1	1	187
49	1	1	41	1	1	67
50	1	1	41	1	1	169
56	1	1	39	1	1	110
57	2	2	42-77	2	2	170-231
59	6	0	--	6	6	69-217
60	7	6	45-141	7	7	181-680
62	11	7	34-73	11	11	89-329
63	2	1	38	2	2	77-111
	T 36	21		36	36	

Table 6. Paralytic shellfish poison (PSP) results - Serripes groenlandicus

Block no.	Meats only			Viscera		
	No. of samples	No. positive	Range of means (µg PSP/100 g)	No. of samples	No. positive	Range of means (µg PSP/100 g)
48	1	0	--	1	1	36
50	1	1	71	1	1	1,000
54	1	0	--	1	1	57
57	2	0	--	2	1	46
60	3	0	--	3	1	53
	T 8	1		8	5	

Table 7. Paralytic shellfish poison (PSP) results - Serripes laperousii

Block No.	Meats only			Viscera		
	No. of samples	No. positive	Range of means (µg PSP/100 g)	No. of samples	No. positive	Range of means (µg PSP/100 g)
48	1	0	--	1	0	--
57	1	0	--	1	1	37
60	2	0	--	2	1	38
62	1	0	--	1	0	--
	T 5	0		5	2	

Table 8. Paralytic shellfish poison (PSP) results - Siliqua alta

Block no.	Meats only			Viscera		
	No. of samples	No. positive	Range of means (µg PSP/100 g)	No. of samples	No. positive	Range of means (µg PSP/100 g)
50	1	1	56	1	1	310
56	1	1	41	1	1	190
57	2	2	44-92	2	2	135-146
	T 4	4		4	4	

the Food and Drug Administration. Two other edible portion samples showed positive PSP on the first analyses. These were samples corresponding to seven bags of production samples. These were segregated from the remainder of the production lots and re-sampled. The assay of these clam meats was negative for PSP. Apparently the first test results were false-positives. Therefore, only two surf clam meat samples contained detectable toxin. Since the viscera portion of these clams had relatively high toxin levels, it is reasonable that the meats might contain the toxin also. However, it is also possible that the toxin detected in the meat portions was present as the result of poor separation and cleaning technique.

A total of 35 surf clam viscera samples, 19% of the 185 analyzed, contained detectable amounts of PSP ranging from 28 µg/100 g to 271 µg/100 g. Of the 35 with detectable toxin, 28 had levels below 50 µg/100 g, and 3 had levels over 80 µg/100 g. The viscera from clams taken on 5 July from hauls 11, 12, and 13 had toxin levels of 271 µg/100 g, 234 µg/100 g, and 137 µg/100 g, respectively. Two of these, from hauls 11 and 12, correspond to the meat samples that were found to contain toxin. As mentioned previously, the toxin detected in the meats may have been the result of contamination from the viscera.

Tellin Clam Results.--A total of 133 tellin clam samples were collected and analyzed for PSP. As with the other clam samples, the meat and viscera were analyzed separately. The results are presented in Table 4.

There were 12 tellin meat-only samples out of the total of 133 that showed detectable toxin. The values were all below 80 µg/100 g, ranging from 27 µg/100 g to 65 µg/100 g.

The tellin viscera samples usually showed detectable toxin. There were 113 of the 133 samples that were positive for PSP. Forty-one of these had toxin over 80 µg/100 g. The highest value was 400 µg/100 g. Blocks 46, 49, 50, 51, 53, 54, 56, 57, 59, and 60 all had tellin samples with toxin over 80 µg/100 g viscera.

Miscellaneous Clam Results.--The results of PSP analyses of the four minor clam species are presented in Tables 5-8. The Macoma spp. usually showed detectable toxin in the meat-only sample, and every viscera sample contained toxin. Twenty-one of the 36 meat samples analyzed contained detectable toxin, but only four were above 80 µg/100 g. These were from block 60. The Macoma viscera samples contained toxin ranging from 45 µg/100 g to 680 µg/100 g.

The cockle, Serripes groenlandicus, was sampled in 5 blocks: 48, 50, 54, 57, and 60. From a total of eight samples, one meat sample contained detectable toxin and five viscera samples contained detectable toxin. A single viscera sample from block 50 showed PSP at 1,000 µg/100 g viscera. This is the highest value observed in any of the Bering Sea clams we analyzed.

The cockle, Serripes laperousii, was sampled in blocks 48, 57, 60, and 62. From a total of five samples, two viscera samples were found to be slightly toxic.

Four samples of the razor clam, Siliqua alta, were taken from blocks 50, 56, and 57. Toxin was detected in all of the meat and viscera samples of this clam. The values ranged from 41 µg/100 g to 92 µg/100g in the meat and from 135 µg/100 g to 310 µg/100 g in the viscera.

PRODUCT EVALUATION STUDIES

Most of the 60,000 pounds of whole, frozen surf clams and the 3,200 pounds of surf clam meats returned to Seattle in August 1978, have been tested by industry participants.

Whole clams were thawed and processed using automatic shucking and eviscerating equipment normally used in the east coast Atlantic surf clam industry. Various test products were prepared to satisfy each company's information needs.

Results of all industry evaluations have been favorable. Both automatic shucking and eviscerating procedures proved effective on the Alaskan surf clam, and meat yields were reported to be higher than obtained from the Atlantic species. Various product qualities were reported as "directly comparable with or as good as" the Atlantic species.

ENVIRONMENTAL IMPACT STUDIES

Results of the 1978 studies describing the effects of hydraulic clam harvesting in the Bering Sea have been concluded and are available at the North Pacific Fishery Management Council in Anchorage, AK. That work cannot be summarized in any detail in this report; however, impacts were generally found to be immeasurable or minor with no evidence of large-scale or wide spread destruction of the environment, abiotic or biotic.

FINANCIAL FEASIBILITY STUDY PURVIEW

Information on vessel operating costs, which are expected to occur, and income resulting from landings have been compiled to aid in evaluating the feasiblity of conducting a Bering Sea surf-clam fishery. A number of assumptions and generalizations are incorporated in this analysis; while each are identified, not all may prove true or be the most economical approach.

The hypothetical prototype vessel chosen for this analysis is a 108 ft crabber/trawler steel vessel with an 850 hp main engine. The vessel would be equipped with twin 150 hp auxiliary engines, hydraulic power on deck, and three circulating seawater live tanks below deck with an 8,000 cubic foot capacity. Cost of such a vessel was set at $1.5 million; however, replacement cost would approach $2.2 million. To enter the fishery, the vessel would have to purchase and install twin 450 hp engine pumps with 6,000 g/min pumps, at a cost of about $30,000 each (deck mounted), trawl winches, twin stiff arms (costs would vary considerably by vessel), and clam-sorting deck gear at a cost of $25,000.

The prototype gear would consist of twin 10-ft wide hydraulic clam harvesters at a cost of $10,000 each.

In this analysis, it is assumed the vessel would operate 24 hours a day with a six-man crew. During the 24-h day, the harvesters would be fished 17 h per day, and the catch would be placed directly in live tanks.

Vessel operating costs and income have been computed on a daily basis, a trip basis, and a monthly basis. It is assumed the vessel would

unload live clams by pump at Port Moller. A 5-day trip time has been calculated to consist of 3 days' fishing, 1 day running and unloading, and 1 day scouting and/or weather loss. Thus, 6 trips per month are projected.

The following calculations are offered:

Operating Cost Per Fishing Day

Fuel @ 7 gal/hr/100 hp	=	2667 gal/fishing day
@ 60¢/gal	=	$1600 /fishing day
Lub costs	=	$ 30 /fishing day
Vessel hull Ins. @1.5%/yr	=	$ 62 /day
Personnel Injury Ins.	=	$ 33 /day for 6 men
Vessel & gear maintenance	=	$ 100 /day
Total		$1825 /day

Operating Costs Per Non-Fishing Day

Fuel @ 7 gal/hr/100 hp	=	1333 gal/day
@ 60¢/gal	=	$ 800 /day
Lub costs	=	$ 15 /day
Vessel hull Ins. @ 1.5%/yr	=	$ 62 /day
Personnel Injury Ins.	=	$ 33 /day
Vessel & gear maintenance	=	$ 100 /day
Total		$1010 /day

Operating Costs Per Trip - 3 days fishing, 2 days non-fishing =$ 7,675

Reasonable crew share @ $300/manday + $500/skipper day = 10,000

$17,675

Operating Costs Per Month - 6 trips per month

$17,675/trip = $106,050/month

Vessel Landings extrapolated from 21 bushel/hr with 6' harvester during research

Twin 10' harvesters	=	70 bushel/h
@ 17 h/day	=	1,190 bushel/day
@ 3 fishing days/trip	=	3,570 bushel/trip
@ 80 lb/bushel	=	285,600 lb/trip
@ 6 trips/month	=	21,420 bushel/month
	=	1,713,600 lb/month

Vessel Income from Landings

3,570 bushel/trip @ $8.00/bushel	= $ 28,560/trip
21,420 bushel/month @ $8.00/bushel	= $171,360/month

Vessel Income Less Operating Costs

$ 28,560/trip less $17,675/trip	= $10,885/trip
$171,360/month less $106,050/month	= $65,310/month*

*This figure is not profit. Vessel depreciation and construction loan costs (interest and principle) have not been figured in operating expenses.

CONCLUSIONS

During 1977 and 1978 surveys, a substantial data base has been developed for industry to evaluate the desirability of initiating a surf clam fishery in the SE Bering Sea and for government agencies to regulate its utilization.

While the surf clam resource along the Port Moller-Ugashik Bay area of the Alaska Peninsula is extensive and would yield 19-25 million pounds of meat per year, the clam concentrations are not as dense as those known in the Atlantic surf clam fishery. The production fishing rates obtained with the 6-ft clam harvester (average 21.0 bu/h) are somewhat lower than anticipated. The high incidental catch of starfish in most areas may be a clue to the low densities as starfish are the surf clam's primary predator. If a fishery does develop, it would be wise management to require vessels to grind starfish catches before returning them to the sea.

Starfish and old clam shells were continuously present in catches, which makes hand sorting of clams impractical. Mechanical catch sorters like those used in some areas of the Atlantic fishery would be highly desirable along the Alaska Peninsula.

The second year resource assessment survey (1978) generally complimented the initial 1977 survey results. The combined data base indicates a 277,000-381,000 mt resource of harvestable size surf clams occurs over a 2,000 square-mile area. The initial estimates annual yield, which this resource should sustain (19-25 million pounds of meat), appear realistic due to the substantiated size of the resource. However, further studies now in progress indicate a longer life span and slower growth than first reported by Feder et al. (1978). Slower growth rates will dictate lower annual yield.

The presence of PSP in the areas surveyed in 1977 and 1978 indicates that some degree of PSP can be expected in the future. The fact that only 2 of 185 samples of surf clam meats contained detectable amounts of toxin this year and none were found with toxin in 1977 suggests that the surf clam may not be seriously affected by PSP. Further, there is a good possibility that the two meat samples with detectable toxin were really not toxic but were contaminated by toxin from the viscera. In preparation of samples for PSP analyses, the meats are not washed or rinsed. Hence, liquid from the viscera may have been transferred to the edible meat samples. It is significant that only 19% of the surf-clam viscera samples showed detectable toxin. Of these, only three had toxin levels above 80 µg/100 g. This is in contrast to the toxin levels found in the tellin viscera samples, which showed detectable toxin in 79% of the samples with 41 of 105 at levels above 80 µg/100 g. Apparently there is a differential uptake of the toxin among clam species. Since surf clams are filter feeders and tellins are detritus feeders, one can speculate that feeding habits have an affect on toxin intake. Further investigation to clarify this would be useful. One more season of testing for PSP is most desirable. Samples taken periodically over the season covering the same geographic area as the 1978 survey would add significantly to our knowledge on the potential of a PSP problem in these clams.

The PSP potential must be recognized and dealt with before any commercial harvesting can proceed. The surf clam will likely be safe to use but should be tested routinely. A lot-by-lot monitoring program would be a reasonable approach to PSP testing.

The financial feasibility study indicates that a 108-ft prototype vessel equipped with twin 10-ft clam harvesters can expect to operate at a reasonable profit level. The study also indicates that vessels of this size could not operate at a reasonable profit if significantly smaller gear were employed. Furthermore, production rates in this study were obtained by experienced surf-clam fishermen who were continually "tuning" the harvester to variable substrate conditions encountered. Thus, as with any new fishery, initial catch rates will probably be less than reported here until proficiency is perfected and knowledge of the grounds expanded.

ACKNOWLEDGEMENTS

The cooperation by all participants was again excellent in 1978. Special thanks are extended to Pete Harris of New England Fish Company for his extra efforts in assisting Captain Roberts' preparation of the Sea Hawk for the cruise. Dale Dwight, superintendent of Peter Pan, Port Moller plant, was extremely helpful during the survey and assisted the joint venture in many ways. Captain Roberts and his crew on the Sea Hawk must be thanked for their 110% efforts which prevailed throughout the survey.

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APPENDIX

Haul position and surf clam catch by haul in the S.E. Bering Sea, July-August 1978

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.W Deg Min	Surf clam Catch lb
1	7-4	40	20	10	32851.6	45451.9	57°46.7'	158°29.2'	34
2	7-4	41	13	10	32829.6	45325.6	57°44.1'	158°10.3'	15
3	7-4	43	15	16	32879.1	45317.1	57°34.9'	158°09.3'	103
4	7-5	42	22	10	32925.4	45444.0	57°33.2'	158°28.4'	2
5	7-5	45	17	10	32955.3	45425.9	57°26.8'	158°25.7'	114
6	7-5	46	20	10	33000.3	45512.7	57°23.3'	158°38.7'	134
7	7-5	45	18	10	32995.1	45457.7	57°21.2'	158°30.5'	148
8	7-5	44	10	10	32943.5	45332.9	57°23.9'	158°11.8'	50
9	7-5	49	15	10	33030.3	45459.6	57°14.6'	158°30.6'	52
10	7-5	48	22	10	33064.8	45571.3	57°14.5'	158°47.3'	18
11	7-5	50	11	10	33114.7	45574.2	57°05.0'	158°47.3'	116
12	7-5	51	20	8	33145.9	45682.2	57°05.5'	159°03.5'	2
13	7-5	54	19	11	33210.1	45790.2	56°59.7'	159°19.3'	28
14	7-6	57	18	12	33350.2	45948.3	56°41.6'	159°41.7'	218

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
15	7-6	56	15	12	33296.9	45833.6	56°44.8'	159°24.8'	39
16	7-6	59	9	10	33374.8	45950.2	56°36.5'	159°41.6'	511
17	7-6	60	15	12	33429.5	46078.9	56°34.2'	160°00.7'	56
18	7-6	63	11	10	33459.0	46101.5	56°29.4'	160°03.8'	55
19	7-6	62	13	12	33515.6	46200.1	56°24.5'	160°18.2'	0
20	7-6	65	17	10	33600.3	46349.1	56°17.4'	160°40.1'	21
21	7-7	60	20	10	33415.9	46063.5	56°36.0'	159°58.6'	143
22	7-7	60	20	10	33413.9	46062.0	56°36.3'	159°58.4	138
23	7-7	60	19	10	33417.2	46065.6	56°35.8'	159°58.9'	183
24	7-7	60	19	10	33419.4	46068.9	56°35.6'	159°59.3'	179
25	7-7	60	20	10	33417.6	46067.2	56°35.9'	159°59.1'	181
26	7-7	60	19	10	33419.0	46067.8	56°35.6'	159°59.2'	182
27	7-7	60	19	10	33417.5	46066.8	56°35.9'	159°59.1'	284
28	7-7	60	19	10	33420.7	46070.1	56°35.4'	159°59.5'	369
29	7-7	60	18	10	33418.6	46067.9	56°35.7'	159°59.2'	166
30	7-7	60	18	10	33420.1	46069.2	56°35.5'	159°59.4'	210
31	7-7	60	18	12	33417.4	46065.6	56°35.8	159°58.9'	214

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
32	7-7	60	18	15	33417.2	46066.5	56°35.9'	159°59.0'	347
33	7-7	60	20	10	33418.5	46066.5	56°35.6'	159°59.0'	247
34	7-7	57	18	10	33370.6	45976.7	56°39.3'	159°45.8'	139
35	7-7	57	17	9	33367.3	45968.5	56°39.4'	159°44.6'	127
36	7-7	57	17	8	33353.8	45945.4	56°40.6'	159°41.2'	61
37	7-7	57	17	10	33348.9	45935.3	56°41.0'	159°39.7'	49
38	7-7	57	16	10	33331.9	45921.2	56°43.6'	159°37.8'	517
39	7-7	57	16	10	33334.5	45921.1	56°43.0'	159°37.8'	257
40	7-7	57	16	10	33334.7	45918.2	56°42.8'	159°37.3'	249
41	7-7	57	16	10	33335.6	45915.9	56°42.4'	159°36.9'	84
42	7-8	59	8	10	33373.4	45947.5	56°36.6'	159°41.2'	492
43	7-8	59	8	10	33374.9	45950.1	56°36.5'	159°41.6'	720
44	7-8	59	10	10	33373.9	45954.8	56°37.0'	159°42.4'	219
45	7-8	59	11	15	33375.5	45958.4	56°36.9'	159°42.9'	515
46	7-8	59	8	11	33374.0	45949.1	56°36.6'	159°41.5'	611
47	7-12	59	10	10	33370.6	45944.7	56°37.0'	159°40.8'	13
48	7-12	59	9	5	33370.8	45942.1	56°36.8'	159°40.4'	2

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
49	7-12	59	9	10	33381.8	45965.2	56°36.1'	159°43.8'	237
50	7-12	59	9	8	33383.4	45968.2	56°36.0'	159°44.3'	198
51	7-12	59	11	10	33385.1	45975.1	56°36.1'	159°45.3'	46
52	7-12	59	12	10	33385.4	45982.8	56°36.6'	159°46.5'	396
53	7-12	59	13	10	33384.8	45983.0	56°36.7'	159°46.6'	226
54	7-12	59	15	10	33382.7	45983.7	56°37.2'	159°46.7'	177
55	7-12	59	16	20	33382.7	45983.7	56°37.2'	159°46.7'	0
56	7-12	59	16	20	33379.2	45988.4	56°38.3'	159°47.5'	0
57	7-12	59	18	10	33376.7	45991.9	56°39.1'	159°48.1'	122
58	7-12	59	19	10	33377.6	45994.9	56°39.1'	159°48.5	192
59	7-12	59	17	10	33382.6	46002.2	56°38.6'	159°49.6'	312
60	7-12	59	18	10	33387.0	46009.9	56°38.2'	159°50.7'	431
61	7-12	59	19	16	33390.6	46017.1	56°38.0'	159°51.8'	354
62	7-12	60	19	10	33392.3	46020.7	56°37.9'	159°52.3'	284
63	7-12	60	19	10	33391.6	46018.9	56°37.9'	159°52.0'	412
64	7-12	59	19	10	33381.3	46019.1	56°40.1'	159°52.2'	355
65	7-12	59	10	10	33372.7	45950.1	56°36.9'	159°41.6'	271

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
66	7-12	59	10	30	33372.1	45948.3	56°36.9'	159°41.4'	374
67	7-12	59	10	15	33372.5	45947.4	56°36.8'	159°41.2'	410
68	7-12	59	10	15	33372.3	45947.5	56°36.8'	159°41.3'	286
69	7-12	59	10	30	33373.3	45948.6	56°36.7	159°41.4'	836
70	7-12	59	10	30	33372.4	45947.9	56°36.8'	159°41.3'	891
71	7-12	59	9	30	33372.6	45948.0	56°36.8'	159°41.3'	555
72	7-12	59	9	30	33372.0	45946.1	56°36.8'	159°41.0'	990
73	7-12	59	9	30	33372.8	45948.3	56°36.8'	159°41.4'	751
74	7-12	59	9	30	33372.8	45946.9	56°36.7'	159°41.1'	615
75	7-12	59	9	30	33372.3	45947.5	56°36.8'	159°41.3'	809
76	7-12	59	9	30	33372.5	45947.5	56°36.8'	159°41.2'	410
77	7-13	59	9	17	33372.1	45947.2	56°36.9'	159°41.2'	323
78	7-13	59	9	30	33374.1	45951.4	56°36.7'	159°41.8'	275
79	7-13	59	9	16	33372.0	45951.0	56°37.2'	159°41.8'	248
80	7-13	59	9	10	33373.7	45952.8	56°36.9'	159°42.1'	247
81	7-13	59	9	15	33374.5	45952.3	56°36.7'	159°42.0	364
82	7-13	59	9	30	33375.6	45952.0	56°36.5'	159°41.9'	830

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
83	7-13	59	9	30	33375.6	45952.4	56°36.5'	159°42.0'	880
84	7-13	59	9	30	33375.3	45951.7	56°36.5'	159°41.9'	627
85	7-13	59	8	30	33373.3	45948.5	56°36.7'	159°41.4'	649
86	7-13	59	8	30	33373.7	45947.6	56°36.5'	159°41.2'	763
87	7-13	59	8	30	33374.2	45948.5	56°36.5'	159°41.4'	586
88	7-13	59	8	30	33374.2	45948.3	56°36.5'	159°41.3'	739
89	7-13	59	8	30	33372.6	45947.7	56°36.8'	159°41.3'	324
90	7-13	59	8	30	33373.1	45947.6	56°36.7'	159°41.3'	564
91	7-13	59	8	30	33373.9	45947.1	56°36.5'	159°41.2'	522
92	7-13	59	8	30	33374.4	45947.8	56°36.4'	159°41.3'	541
93	7-15	57	18	10	33387.9	46010.2	56°38.1'	159°50.7'	293
94	7-15	57	18	5	33386.2	46006.5	56°38.2'	159°50.2'	0
95	7-15	57	17	10	33386.3	46009.9	56°38.4'	159°50.7'	240
96	7-15	57	18	9	33386.0	46011.2	56°38.5'	159°50.9'	82
97	7-15	57	18	10	33387.7	46013.4	56°38.3'	159°51.2'	206
98	7-15	57	18	10	33389.0	46015.0	56°38.2'	159°51.5'	90
99	7-15	57	18	10	33389.7	46015.1	56°38.0'	159°51.5'	283

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
100	7-15	57	18	10	33392.5	46019.9	56°37.8'	159°52.2'	319
101	7-15	57	18	10	33390.4	46016.5	56°38.0'	159°51.7'	258
102	7-15	57	18	15	33389.0	46014.8	56°38.2'	159°51.4'	299
103	7-15	57	18	15	33389.1	46014.3	56°38.1'	159°51.4'	279
104	7-15	57	18	10	33388.9	46013.7	56°38.1'	159°51.3'	217
105	7-15	57	18	11	33388.3	46011.5	56°38.1'	159°50.9'	202
106	7-15	57	18	10	33392.9	46020.5	56°37.7'	159°52.3'	187
107	7-15	57	18	10	33390.5	46017.1	56°38.0'	159°51.8'	128
108	7-15	57	17	10	33332.3	45923.3	56°43.6'	159°38.1'	323
109	7-15	57	17	10	33332.1	45921.8	56°43.6'	159°37.9'	444
110	7-15	57	17	10	33330.7	45920.3	56°43.8'	159°37.7'	318
111	7-15	57	17	10	33330.4	45919.2	56°43.7'	159°37.5'	319
112	7-15	57	17	10	33331.8	45920.6	56°43.5'	159°37.7'	290
113	7-15	57	17	10	33332.7	45922.5	56°43.5'	159°38.0'	182
114	7-15	57	17	10	33334.0	45923.0	56°43.2'	159°38.1'	412
115	7-15	57	17	10	33329.4	45913.3	56°43.5'	159°36.6'	466

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
116	7-16	57	17	10	33330.7	45915.8	56°43.4'	159°37.0'	282
117	7-16	57	18	10	33330.3	45913.0	56°43.3'	159°36.6'	275
118	7-16	57	17	10	33330.2	45914.4	56°43.4'	159°36.8'	285
119	7-16	57	20	10	33328.0	45920.7	56°44.3'	159°37.8'	202
120	7-16	57	19	10	33328.0	45920.6	56°44.3'	159°37.8'	242
121	7-16	57	18	10	0	0	0 0	0 0	281
122	7-16	57	18	5	33334.0	45927.3	56°43.5'	159°38.7'	211
123	7-16	57	18	10	33337.8	45930.6	56°43.0'	159°39.2'	328
124	7-16	57	17	10	33337.8	45930.6	56°43.0'	159°39.2'	400
125	7-16	57	17	10	33335.0	45922.0	56°43.0'	159°37.9'	64
126	7-16	57	17	10	33332.6	45916.0	56°43.0	159°37.0'	528
127	7-16	57	17	15	33327.8	45915.6	56°44.0'	159°37.0'	461
128	7-16	57	16	30	33334.5	45925.9	56°43.3'	159°38.5'	758
129	7-16	57	16	5	33334.5	45925.5	56°43.3'	159°38.5'	0
130	7-16	57	16	17	33334.3	45925.1	56°43.3'	159°38.4'	579
131	7-16	57	16	30	33334.5	45925.7	56°43.3;	159°38.5'	761

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
132	7-16	57	16	30	33334.7	45926.4	56°43.3'	159°38.6'	787
133	7-16	57	16	30	33332.0	45922.1	56°43.6'	159°38.0'	751
134	7-16	57	16	30	33333.5	45924.8	56°43.5'	159°38.4'	806
135	7-16	57	16	30	33332.7	45923.1	56°43.5'	159°38.1'	891
136	7-16	57	16	30	33333.0	45924.3	56°43.5'	159°38.3'	788
137	7-17	56	10	10	33317.2	45852.2	56°41.8'	159°27.4'	55
138	7-17	56	11	10	33315.3	45850.0	56°42.0'	159°27.1'	10
139	7-17	56	8	4	33308.0	45832.0	56°42.3	159°24.4'	0
140	7-17	56	9	6	33292.0	45804.0	56°43.8'	159°20.3'	75
141	7-17	56	9	7	33283.0	45788.0	56°44.6'	159°18.0'	88
142	7-17	56	10	12	33274.0	45776.0	56°45.6'	159°16.3'	163
143	7-17	56	10	17	33272.0	45772.0	56°45.8'	159°15.7'	102
144	7-17	53	10	8	33264.0	45757.0	56°46.4'	159°13.5'	0
145	7-17	53	10	8	33254.0	45739.0	56°47.3'	159°10.8'	0
146	7-17	53	9	8	33246.0	45721.0	56°47.7'	159°08.2'	0
147	7-17	53	12	10	0	0	0 0	0 0	0

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
148	7-18	57	16	16	33331.9	45921.4	56°43.6'	159°37.9'	498
149	7-18	57	16	21	33332.1	45921.7	56°43.6'	159°37.9'	504
150	7-18	57	16	20	33332.0	45921.5	56°43.6'	159°37.9'	485
151	7-18	57	16	20	33332.2	45921.4	56°43.5'	159°37.9'	538
152	7-18	57	16	13	33332.2	45921.3	56°43.5'	159°37.8'	414
153	7-18	57	16	15	33331.8	45921.8	56°43.6'	159°37.9'	350
154	7-18	57	16	20	33334.0	45923.9	56°43.3'	159°38.2'	444
155	7-18	57	17	20	33332.5	45916.7	56°43.1'	159°37.1'	430
156	7-18	57	17	25	33332.5	45917.6	56°43.2'	159°37.3'	345
157	7-18	57	17	17	0	0	0 0	0 0	132
158	7-18	57	17	20	33333.7	45919.4	56°43.1'	159°37.5'	727
159	7-18	57	16	25	33332.9	45918.0	56°43.1'	159°37.3'	564
160	7-18	57	16	25	33332.5	45917.1	56°43.1'	159°37.2'	513
161	7-18	57	17	25	33332.7	45917.2	56°43.1'	159°37.2'	574
162	7-18	57	16	30	33332.1	45917.9	56°43.3'	159°37.3'	577
163	7-18	57	16	30	33334.0	45924.4	56°43.3'	159°38.3'	786

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
164	7-18	57	16	30	0	0	0 0	0 0	656
165	7-19	0	14	10	33849.7	46799.0	55°58.1'	161°47.2'	0
166	7-19	0	14	5	33849.8	46798.0	55°58.0'	161°47.0'	0
167	7-19	0	13	5	33849.4	46794.3	55°57.8'	161°46.4'	0
168	7-19	0	10	5	33842.6	46762.9	55°56.5'	161°41.6'	0
169	7-19	0	17	5	33827.1	46756.1	55°59.6'	161°40.7'	0
170	7-19	0	18	5	33812.3	46732.9	56°01.1'	161°37.2'	2
171	7-19	0	18	5	33799.6	46702.5	56°01.4'	161°32.6'	1
172	7-19	0	19	3	33767.5	46645.9	56°03.9'	161°24.2'	0
173	7-19	0	9	4	33750.4	46572.0	56°01.4'	161°12.8'	0
174	7-21	57	17	10	33333.8	45925.1	56°43.4'	159°38.4'	324
175	7-21	57	17	10	33334.0	45924.9	56°43.4'	159°38.4'	303
176	7-21	57	17	10	33334.0	45923.9	56°43.3'	159°38.2'	346
177	7-21	57	17	10	33332.1	45922.1	56°43.6'	159°38.0'	330
178	7-21	57	17	10	33332.1	45922.0	56°43.6'	159°37.9'	252
179	7-21	57	17	10	33331.8	45922.0	56°43.6'	159°38.0'	340

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
180	7-21	57	17	14	33331.8	45921.9	56°43.6'	159°37.9'	349
181	7-21	57	17	12	33332.0	45921.6	56°43.6'	159°37.9'	246
182	7-21	57	17	13	33332.0	45922.1	56°43.6'	159°38.0'	247
183	7-21	57	17	13	33332.1	45922.2	56°43.6'	159°38.0'	211
184	7-21	57	18	12	33331.8	45922.0	56°43.6'	159°38.0'	221
185	7-21	57	17	12	33331.9	45921.7	56°43.6'	159°37.9'	268
186	7-21	57	17	13	33331.9	45921.4	56°43.6'	159°37.9'	222
187	7-21	57	17	14	33331.9	45921.6	56°43.6'	159°37.9'	240
188	7-21	57	17	10	33331.4	45916.4	56°43.3'	159°37.1'	244
189	7-21	57	17	10	33329.8	45914.3	56°43.5'	159°36.8'	344
190	7-21	57	17	10	33331.9	45916.5	56°43.2'	159°37.1'	256
191	7-21	57	17	15	33332.3	45917.2	56°43.2'	159°37.2'	281
192	7-21	57	17	10	33332.3	45917.0	56°43.2'	159°37.2'	361
193	7-21	57	17	10	33332.5	45917.7	56°43.2'	159°37.3'	232
194	7-21	57	16	10	33333.2	45918.1	56°43.1'	159°37.3'	220
195	7-21	57	16	10	33332.3	45917.5	56°43.2'	159°37.2'	166

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
196	7-21	57	16	10	33332.9	45918.0	56°43.1'	159°37.3'	426
197	7-21	57	16	10	33332.2	45917.2	56°43.2'	159°37.2'	316
198	7-21	57	16	10	33332.2	45916.9	56°43.2'	159°37.2'	273
199	7-21	57	0	15	33332.5	45917.1	56°43.1'	159°37.2'	406
200	7-21	57	16	15	33332.9	45918.0	56°43.1'	159°37.3'	308
201	7-21	57	16	15	33333.4	45918.0	56°43.0'	159°37.3'	194
202	7-21	57	16	15	33332.2	45916.8	56°43.2'	159°37.1'	290
203	7-21	57	16	15	33331.6	45915.6	56°43.2'	159°37.0'	269
204	7-22	50	16	10	33116.2	45605.9	57°06.6'	158°52.1'	106
205	7-22	50	16	10	33109.7	45596.3	57°07.3'	158°50.7'	14
206	7-22	50	13	5	33107.0	45582.7	57°07.0	158°48.7'	45
207	7-22	50	12	1	33103.1	45561.2	57°06.5'	158°45.5'	0
208	7-22	50	10	5	33101.0	45551.9	57°06.3'	158°44.1'	175
209	7-22	50	12	5	33089.2	45543.0	57°08.1'	158°42.8'	9
210	7-22	49	10	5	33073.2	45497.6	57°08.5'	158°36.1'	25
211	7-22	49	8	5	33061.8	45474.4	57°09.3'	158°32.6'	0
212	7-22	49	16	5	33052.7	45496.7	57°12.4'	158°36.1'	30

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
213	7-22	49	18	15	33052.9	45506.1	57°12.9'	158°37.5'	37
214	7-22	48	20	5	33051.1	45513.0	57°13.7'	158°38.6'	4
215	7-22	49	17	14	33052.6	45503.0	57°12.8'	158°37.0'	12
216	7-22	48	19	14	33056.9	45514.6	57°12.7'	158°38.8'	11
217	7-22	50	17	8	33084.6	45562.1	57°10.1'	158°45.8'	41
218	7-22	50	16	10	33094.1	45576.0	57°09.1'	158°47.8'	92
219	7-22	50	16	10	33100.6	45586.5	57°08.5'	158°49.3'	70
220	7-22	50	16	4	33107.5	45597.3	57°07.8'	158°50.9'	66
221	7-22	50	14	10	33119.7	45608.8	57°06.1'	158°52.6'	159
222	7-22	50	13	12	33119.9	45606.4	57°05.9'	158°52.2'	348
223	7-22	50	13	12	33118.7	45605.4	57°06.1'	158°52.0'	165
224	7-22	50	15	12	33117.4	45606.4	57°06.4'	158°52.2'	231
225	7-22	50	15	12	33116.5	45607.7	57°06.7'	158°52.4'	166
226	7-22	50	15	15	33115.9	45608.3	57°06.8'	158°52.5'	210
227	7-22	50	15	12	33115.0	45605.6	57°06.8'	158°52.1'	191
228	7-22	50	12	13	33118.9	45605.5	57°06.1'	158°52.1'	56

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
229	7-22	50	13	12	33117.6	45605.4	57°06.3'	158°52.1'	83
230	7-23	50	13	12	33119.6	45606.0	57°06.0'	158°52.1'	339
231	7-23	50	13	12	33119.6	45605.5	57°05.9'	158°52.1'	392
232	7-23	50	16	12	33117.0	45608.2	57°06.6'	158°52.5'	211
233	7-23	50	16	10	33116.7	45610.8	57°06.8'	158°52.9'	166
234	7-23	50	17	11	33114.7	45607.4	57°07.0'	158°52.4'	212
235	7-23	50	17	8	33112.9	45605.5	57°07.2'	158°52.1'	113
236	7-23	50	17	10	33111.4	45607.3	57°07.7'	158°52.4'	110
237	7-23	50	18	12	33113.6	45609.2	57°07.3'	158°52.7'	46
238	7-23	50	16	12	33115.8	45605.7	57°06.7'	158°52.1'	183
239	7-23	50	16	12	33116.6	45606.5	57°06.6'	158°52.2'	151
240	7-23	50	14	15	33119.1	45606.1	57°06.1'	158°52.2'	295
241	7-23	50	14	15	33119.1	45606.1	57°06.1'	158°52.2'	366
242	7-23	50	14	10	33119.8	45607.1	57°06.0'	158°52.3'	171
243	7-23	50	16	10	33116.4	45604.3	57°06.5'	158°51.9'	91
244	7-23	50	14	15	33119.2	45605.1	57°06.0'	158°52.0'	459

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
245	7-23	50	14	15	33119.4	45605.7	57°06.0'	158°52.1'	293
246	7-23	50	14	15	33118.5	45604.4	57°06.1'	158°51.9'	398
247	7-23	50	14	15	33119.3	45605.6	57°06.0'	158°52.1'	377
248	7-23	48	19	10	33057.2	45522.1	57°13.1'	158°39.9'	22
249	7-23	48	16	10	33055.4	45508.0	57°12.6'	158°37.8'	31
250	7-23	49	15	10	33053.9	45500.3	57°12.4'	158°36.6'	33
251	7-23	49	14	10	33051.5	45492.0	57°12.4'	158°35.4'	32
252	7-24	57	17	10	33332.0	45915.3	56°43.1'	159°36.9'	376
253	7-24	57	17	10	33332.4	45915.2	56°43.0'	159°36.9'	309
254	7-24	57	17	10	33333.1	45915.9	56°42.9'	159°37.0'	339
255	7-24	57	17	10	33333.6	45915.7	56°42.8'	159°36.9'	426
256	7-24	57	17	15	33333.6	45915.7	56°42.8'	159°36.9'	385
257	7-24	57	17	15	33332.7	45916.6	56°43.1'	159°37.1'	481
258	7-24	57	17	12	33332.3	45914.9	56°43.0'	159°36.8'	399
259	7-24	57	17	15	33333.8	45916.5	56°42.8'	159°37.1'	294
260	7-24	57	17	15	33331.7	45912.5	56°43.0'	159°36.5'	501

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
261	7-24	57	17	20	33331.0	45911.8	56°43.1'	159°36.4'	461
262	7-24	57	17	25	33331.8	45913.2	56°43.0'	159°36.6'	403
263	7-24	57	17	30	33331.9	45913.3	56°43.0'	159°36.6'	328
264	7-26	57	17	12	33333.9	45917.6	56°42.9'	159°37.2'	298
265	7-26	57	17	12	33332.7	45915.0	56°43.0'	159°36.9'	313
266	7-26	57	17	12	33331.9	45914.6	56°43.1'	159°36.8'	284
267	7-26	57	17	12	33331.9	45914.9	56°43.1'	159°36.8'	441
268	7-26	57	17	12	33332.2	45915.2	56°43.1'	159°36.9'	406
269	7-26	57	17	10	33335.3	45925.5	56°43.1'	159°38.4'	377
270	7-26	57	17	10	33333.4	45921.9	56°43.3'	159°37.9'	249
271	7-26	57	17	10	33332.9	45920.3	56°43.3'	159°37.7'	173
272	7-26	57	17	10	33334.8	45925.3	56°43.2'	159°38.4'	395
273	7-26	57	17	12	33334.8	45927.7	56°43.4'	159°38.8'	431
274	7-26	57	17	10	33335.4	45924.6	56°43.1'	159°38.3'	343
275	7-26	57	17	10	33335.4	45923.3	56°43.0'	159°38.1'	400
276	7-26	57	17	12	33334.5	45924.1	56°43.2'	159°38.2'	340

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
277	7-26	57	17	12	33334.9	45924.8	56°43.2'	159°38.3'	358
278	7-26	57	17	10	33335.2	45924.4	56°43.1'	159°38.3'	383
279	7-26	59	17	2	33367.1	45967.1	56°39.4'	159°44.4'	0
280	7-26	59	18	10	33371.6	45979.9	56°39.3'	159°46.3'	0
281	7-26	59	18	4	33378.0	45994.9	56°39.1'	159°48.5'	16
282	7-26	59	19	10	33382.4	46006.2	56°38.9'	159°50.2'	76
283	7-26	59	19	10	33387.2	46014.7	56°38.5'	159°51.4'	344
284	7-26	59	19	10	33391.6	46018.0	56°37.8'	159°51.9'	412
285	7-27	59	19	10	33389.5	46016.5	56°38.2'	159°51.7'	359
286	7-27	59	19	10	33389.9	46015.5	56°38.0'	159°51.5'	253
287	7-27	59	19	10	33389.9	46015.5	56°38.0'	159°51.5'	292
288	7-27	57	19	10	33390.9	46018.1	56°38.0'	159°51.9'	418
289	7-27	57	19	15	33390.4	46017.2	56°38.0'	159°51.8'	490
290	7-27	59	19	15	33390.4	46017.4	56°38.0'	159°51.8'	465
291	7-27	60	18	10	33402.2	46034.9	56°36.8	159°54.3'	106
292	7-27	60	19	10	33407.1	46045.3	56°36.5'	159°55.9'	144

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
293	7-27	60	19	10	33409.8	46050.4	56°36.3'	159°56.6'	170
294	7-27	60	18	10	33413.4	46057.2	56°36.0'	159°57.6'	263
295	7-27	60	18	10	33417.3	46064.1	56°35.7'	159°58.6'	266
296	7-27	60	19	12	33417.3	46067.0	56°35.9'	159°59.1'	225
297	7-27	60	19	15	33416.1	46067.2	56°36.2'	159°59.1'	340
298	7-27	60	19	15	33413.8	46064.5	56°36.5'	159°58.8'	0
299	7-27	60	19	15	33413.6	46063.6	56°36.5'	159°58.6'	159
300	7-27	60	18	12	33415.6	46060.8	56°35.8'	159°58.2'	229
301	7-27	60	18	15	33419.8	46069.0	56°35.5'	159°59.4'	413
302	7-27	60	19	10	33418.8	46068.3	56°35.7'	159°59.3'	105
303	7-27	60	18	9	33423.5	46076.2	56°35.3'	160°00.4'	351
304	7-27	60	17	10	33427.9	46085.3	56°35.0	160°01.8'	308
305	7-27	60	17	10	33433.5	46094.7	56°34.5'	160°03.1'	343
306	7-27	60	17	10	33435.8	46099.1	56°34.3'	160°03.8'	568
307	7-27	60	16	10	33442.5	46109.0	56°33.6'	160°05.2'	0

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
308	7-27	60	18	10	33447.5	46115.5	56°33.0'	160°06.1'	36
309	7-27	60	18	10	33454.1	46121.2	56°32.0'	160°06.9'	242
310	7-27	60	15	10	33454.7	46111.2	56°31.1'	160°05.4'	117
311	7-27	60	13	10	33451.7	46099.4	56°30.9'	160°03.6'	142
312	7-27	60	16	5	33451.0	46085.2	56°30.0'	160°01.4'	0
313	7-27	60	12	10	33443.2	46078.6	56°31.2'	160°00.5'	110
314	7-28	60	18	10	33423.6	46077.3	56°35.3'	160°00.6'	498
315	7-28	60	16	10	33423.8	46078.3	56°35.4'	160°00.7'	398
316	7-28	60	16	10	33425.3	46080.4	56°35.2'	160°01.0'	413
317	7-28	60	18	10	33423.7	46078.6	56°35.4'	160°00.8'	334
318	7-28	60	18	10	33425.8	46081.7	56°35.2'	160°01.2'	376
319	7-28	60	18	12	33425.7	46082.0	56°35.2'	160°01.3'	313
320	7-28	60	17	15	33425.8	46082.6	56°35.3'	160°01.4'	216
321	7-28	60	17	15	33424.9	46080.1	56°35.3'	160°01.0'	449
322	7-28	60	18	15	33424.9	46079.6	56°35.2'	160°00.9'	407
323	7-28	60	17	15	33425.3	46080.9	56°35.2'	160°01.1'	431
324	7-28	60	18	15	33422.9	46077.1	56°35.5'	160°00.6'	225

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
325	7-28	62	15	10	33465.7	46140.3	56°30.9'	160°09.7'	260
326	7-28	62	15	10	33473.7	46148.0	56°29.8'	160°10.8'	458
327	7-28	62	15	10	33475.6	46145.3	56°29.1'	160°10.3'	80
328	7-28	62	13	10	0	0	0	0	96
329	7-28	62	13	10	33486.6	46160.4	56°27.9'	160°12.5'	65
330	7-28	62	14	10	33493.7	46171.4	56°27.2'	160°14.1'	0
331	7-28	62	14	10	33498.4	46185.9	56°27.3'	160°16.3'	0
332	7-28	62	16	10	33495.3	46194.6	56°28.6'	160°17.7'	111
333	7-28	62	17	10	33501.7	46206.9	56°28.2'	160°19.5'	180
334	7-28	62	17	10	33507.5	46218.1	56°27.7'	160°21.1'	439
335	7-28	62	16	10	33512.5	46225.8	56°27.2'	160°22.3'	562
336	7-28	62	17	10	33519.6	46235.9	56°26.5'	160°23.7'	176
337	7-28	62	18	10	33526.2	46247.2	56°25.9'	160°25.4'	109
338	7-28	62	20	10	33526.5	46258.5	56°26.7'	160°27.1'	21
339	7-29	53	11	3	33251.8	45755.3	56°48.9'	159°13.4'	0
340	7-29	53	12	3	33244.2	45751.3	56°50.2'	159°12.9'	0

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
341	7-29	53	18	0	33214.9	45751.4	56°56.2'	159°13.3'	0
342	7-29	51	15	5	33159.6	45687.0	57°03.1'	159°04.1'	36
343	7-29	51	15	10	33162.1	45691.3	57°02.9'	159°04.7'	156
344	7-29	51	19	10	33152.2	45680.2	57°04.1'	159°03.1'	64
345	7-29	51	20	10	33137.9	45663.8	57°05.9'	159°00.8'	60
346	7-29	51	20	10	33132.2	45649.8	57°06.2'	158°58.7'	60
347	7-29	50	17	10	33113.9	45608.6	57°07.2'	158°52.6'	116
348	7-29	50	18	15	33105.5	45594.9	57°08.0'	158°50.6'	321
349	7-30	45	18	10	32990.2	45432.2	57°20.6'	158°26.6'	272
350	7-30	45	18	10	32995.6	45428.5	57°19.4'	158°26.1'	205
351	7-30	45	17	10	32987.5	45421.5	57°20.5'	158°25.0'	142
352	7-30	45	17	3	32977.3	45418.6	57°22.3'	158°24.6'	0
353	7-30	45	16	10	32966.9	45411.7	57°23.9'	158°23.6'	176
354	7-30	45	17	10	32957.8	45408.1	57°25.4'	158°23.1'	101
355	7-30	45	17	10	32944.7	45400.4	57°27.4'	158°21.9'	0
356	7-30	45	16	8	32939.1	45403.2	57°28.5'	158°22.3'	119

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
357	7-30	45	18	10	32930.8	45408.1	57°30.3'	158°23.1'	71
358	7-30	45	20	10	32928.3	45419.8	57°31.4'	158°24.8'	5
359	7-30	45	19	10	32946.6	45436.4	57°29.0'	158°27.3'	0
360	7-30	45	18	10	32960.8	45444.5	57°26.8'	158°28.5'	29
361	7-30	45	18	5	32980.3	45475.1	57°24.9'	158°33.1'	43
362	7-30	45	18	10	32982.8	45476.7	57°24.5'	158°33.3'	95
363	7-30	45	19	10	32988.7	45488.8	57°24.1'	158°35.2'	114
364	7-30	45	17	10	32995.2	45457.9	57°21.1'	158°30.5'	178
365	7-30	45	16	10	32996.3	45456.3	57°20.8'	158°30.2'	98
366	7-30	45	17	10	32996.9	45454.5	57°20.6'	158°30.0'	53
367	7-30	45	16	8	32999.5	45433.1	57°18.9'	158°26.7'	270
368	7-30	45	16	10	32998.0	45432.4	57°19.2'	158°26.6'	271
369	7-30	45	17	14	32996.9	45430.1	57°19.2'	158°26.3'	305
370	7-31	45	18	10	32999.5	45434.0	57°19.0'	158°26.9'	128
371	7-31	45	18	10	32997.6	45431.4	57°19.2'	158°26.5'	210
372	7-31	45	18	12	0	0	0	0	173

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
373	7-31	44	14	5	32964.7	45373.8	57°22.2'	158°17.9'	50
374	7-31	44	12	5	32959.4	45360.3	57°22.4'	158°15.9'	78
375	7-31	44	11	5	32948.9	45344.0	57°23.5'	158°13.5'	53
376	7-31	44	8	5	32938.8	45321.5	57°24.1'	158°10.1'	6
377	7-31	44	6	3	32942.6	45308.2	57°22.7'	158°08.1'	0
378	7-31	44	10	5	32945.8	45336.6	57°23.6'	158°12.4'	32
379	7-31	44	11	12	32949.3	45345.2	57°23.5'	158°13.7'	33
380	7-31	44	10	5	32950.8	45345.4	57°23.2'	158°13.7'	69
381	7-31	44	12	5	0	0	0	0	79
382	7-31	44	13	5	32929.4	45345.7	57°27.2'	158°13.7'	127
383	7-31	44	13	10	32924.4	45337.7	57°27.7'	158°12.5'	161
384	7-31	44	12	10	32918.9	45324.5	57°28.0'	158°10.6'	112
385	7-31	44	9	10	32917.6	45313.2	57°27.6'	157°08.9'	70
386	7-31	44	13	10	32933.4	45353.8	57°26.9'	158°14.9'	137
387	7-31	44	15	10	32934.7	45362.3	57°27.1'	158°16.2'	61
388	7-31	44	13	10	32932.4	45350.3	57°26.9'	158°14.4'	181

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
389	7-31	44	13	8	32931.2	45349.4	57°27.1'	158°14.3'	156
390	7-31	44	13	10	0	0	0	0	145
391	7-31	44	13	3	32928.8	45344.5	57°27.3'	158°13.6'	0
392	7-31	44	13	5	32926.7	45340.8	57°27.4'	158°13.0'	0
393	7-31	44	13	12	32930.4	45348.1	57°27.1'	158°14.1'	224
394	7-31	44	13	15	32930.3	45347.7	57°27.1'	158°14.0'	241
395	7-31	44	13	15	32930.7	45347.4	57°27.1'	158°14.0'	223
396	7-31	44	13	15	32931.0	45347.9	57°27.0'	158°14.1'	147
397	7-31	44	13	15	32930.7	45348.6	57°27.1'	158°14.2'	194
398	8-1	43	13	5	32912.1	45317.7	57°28.9'	158°09.5'	140
399	8-1	43	10	5	32920.6	45317.7	57°27.3'	158°09.5'	33
400	8-1	43	12	5	32923.4	45331.0	57°27.5'	158°11.5'	45
401	8-1	43	15	5	32926.0	45342.0	57°27.6'	158°13.2'	0
402	8-1	43	16	5	32913.8	45345.7	57°30.1'	158°13.7'	24
403	8-1	43	16	5	32899.5	45332.6	57°32.0'	158°11.7'	24
404	8-1	43	13	7	32897.3	45323.9	57°31.9'	158°10.4'	78

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
405	8-1	43	13	10	32895.4	45323.9	57°32.3'	158°10.4'	41
406	8-1	43	14	5	32891.1	45314.2	57°32.6'	158°09.0'	5
407	8-1	43	13	5	32888.4	45298.9	57°32.2'	158°06.7'	10
408	8-1	43	13	5	32876.7	45281.0	57°33.4'	158°03.9'	45
409	8-1	43	13	5	32913.0	45319.9	57°28.8'	158°09.9'	113
410	8-1	43	13	0	32915.7	45323.5	57°28.5'	158°10.4'	0
411	8-1	42	15	5	32932.6	45391.1	57°29.1'	158°20.5'	0
412	8-1	42	16	5	32932.0	45392.0	57°29.2'	158°20.7'	68
413	8-1	42	16	5	32939.6	45407.5	57°28.7'	158°23.0'	85
415	8-1	42	17	5	32944.6	45425.3	57°28.7'	158°25.7'	28
416	8-1	42	20	6	32947.5	45447.7	57°29.4'	158°29.0'	26
417	8-1	42	20	10	32935.0	45429.7	57°30.7'	158°26.3'	32
418	8-4	62	16	10	33511.9	46225.2	56°27.3'	160°22.2'	340
419	8-4	62	15	10	33514.1	46227.5	56°27.0'	160°22.5'	102
420	8-4	62	16	10	33511.9	46225.8	56°27.4'	160°22.3'	440
421	8-4	62	16	10	33511.2	46224.4	56°27.4'	160°22.1'	378

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
422	8-4	62	16	10	33511.7	46225.1	56°27.4'	160°22.2'	315
423	8-4	62	16	10	33510.0	46222.8	56°27.6'	160°21.8'	431
424	8-4	62	16	10	33509.2	46221.7	56°27.7'	160°21.7'	351
425	8-4	62	16	10	33512.6	46225.8	56°27.2'	160°22.3'	447
426	8-4	62	16	10	33510.9	46223.3	56°27.4'	160°21.9'	376
427	8-4	62	16	10	33510.1	46222.8	56°27.5'	160°21.8'	439
428	8-4	62	16	10	0	0	0	0	492
429	8-4	62	18	10	33512.3	46230.9	56°27.7'	160°23.1'	101
430	8-5	60	12	10	33450.3	46086.7	56°30.2'	160°01.6'	13
431	8-5	60	21	10	33431.7	46101.4	56°35.4'	160°04.2'	2
432	8-5	56	13	10	33330.1	45883.8	56°41.3'	159°32.1'	475
433	8-5	56	14	10	33320.1	45867.0	56°42.2'	159°29.6'	31
434	8-5	56	12	10	33312.4	45847.5	56°42.5'	159°26.7'	167
435	8-5	56	10	2	33308.1	45833.0	56°42.4'	159°24.5'	0
436	8-5	56	14	5	33299.2	45837.7	56°44.6'	159°25.4'	18
437	8-5	56	15	10	33291.8	45834.2	56°45.9'	159°25.0'	0

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
438	8-5	56	14	10	0	0	0	0	4
439	8-5	56	14	5	33273.9	45809.3	56°47.9'	159°21.4'	0
440	8-5	56	14	5	33308.0	45855.8	56°44.0'	159°28.1'	12
441	8-5	56	13	10	33326.4	45876.1	56°41.5'	159°30.9'	173
442	8-5	56	12	10	33329.1	45880.7	56°41.3'	159°31.6'	92
443	8-5	56	12	10	33331.1	45885.8	56°41.2'	159°32.4'	208
444	8-5	56	13	8	33331.7	45887.7	56°41.2'	159°32.6'	237
445	8-5	57	13	10	33333.1	45890.6	56°41.1'	159°33.1'	255
446	8-5	60	13	10	33464.6	46115.6	56°29.3'	160°05.9'	15
447	8-6	56	13	10	33331.1	45885.3	56°41.2'	159°32.3'	371
448	8-6	56	14	10	33331.2	45884.6	56°41.1'	159°32.2'	188
449	8-6	56	14	10	33331.0	45882.7	56°41.0'	159°31.9'	204
450	8-6	56	14	10	33331.5	45885.6	56°41.1'	159°32.3'	395
451	8-6	56	13	10	33330.6	45884.5	56°41.2'	159°32.2'	205
452	8-6	56	13	10	33330.5	45884.3	56°41.2'	159°32.1'	232
453	8-6	56	14	10	33331.0	45885.4	56°41.2'	159°32.3'	408

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
454	8-6	56	13	10	33331.0	45885.2	56°41.2'	159°32.3'	325
455	8-6	56	13	10	33330.8	45884.7	56°41.2'	159°32.2'	337
456	8-6	56	14	10	33330.7	45884.4	56°41.2'	159°32.1'	363
457	8-6	57	11	10	33347.9	45912.3	56°39.5'	159°36.2'	468
458	8-6	57	11	10	33344.2	45906.5	56°39.9'	159°35.3'	386
459	8-6	57	13	10	33338.8	45899.5	56°40.6'	159°34.4'	317
460	8-6	57	13	10	33336.7	45895.9	56°40.8'	159°33.8'	313
461	8-6	57	11	10	33348.5	45912.2	56°39.4'	159°36.2'	408
462	8-6	57	11	10	33347.0	45911.4	56°39.7'	159°36.1'	438
463	8-6	57	11	10	33346.7	45910.3	56°39.6'	159°35.9'	521
464	8-6	57	11	10	33346.2	45908.5	56°39.6'	159°35.6'	594
465	8-6	57	11	10	33345.9	45909.1	56°39.7'	159°35.7'	418
466	8-6	57	11	10	33346.5	45910.1	56°39.7'	159°35.9'	509
467	8-6	57	11	10	33346.0	45909.4	56°39.7'	159°35.8'	417
468	8-6	57	11	10	33346.7	45909.7	56°39.6'	159°35.8'	581
469	8-7	45	17	10	32956.7	45426.7	57°26.6'	158°25.9'	60

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
470	8-7	44	9	10	32942.0	45332.0	57°24.1'	158°11.7'	98
471	8-7	43	15	10	32879.5	45316.6	57°34.8'	158°09.3'	40
472	8-7	41	14	10	32828.1	45324.6	57°44.4'	158°10.1'	20
473	8-7	40	21	10	32849.7	45448.5	57°46.8'	158°28.7'	19
474	8-7	42	20	10	32924.7	45440.9	57°33.2'	158°28.0'	28
475	8-7	46	20	10	33030.7	45524.6	57°18.3'	158°40.4'	12
476	8-7	48	20	10	33065.4	45570.6	57°14.3'	158°47.2'	12
477	8-7	49	13	10	33030.9	45459.4	57°14.4'	158°30.6'	33
478	8-7	50	12	10	33113.6	45570.7	57°05.0'	158°46.8'	15
479	8-8	51	20	10	33145.9	45682.2	57°05.5'	159°03.5'	15
480	8-8	53	16	10	33200.0	45699.8	56°55.8'	159°05.6'	0
481	8-8	54	14	10	33250.2	45773.9	56°50.4'	159°16.3'	0
482	8-8	54	14	10	33294.7	45831.7	56°45.1'	159°24.5'	556
483	8-8	57	19	10	33348.6	45944.9	56°41.7'	159°41.2'	55
484	8-8	59	9	10	33374.8	45949.9	56°36.5'	159°41.6'	273
485	8-8	60	16	10	33427.4	46074.8	56°34.3'	160°00.1'	60

APPENDIX (continued)

Haul No.	Date	Block No.	Depth fm	Duration Min.	Loran C Y	Loran C Z	Lat.-N Deg Min	Long.-W Deg Min	Surf clam Catch lb
486	8-8	63	10	10	33460.0	46099.5	56°29.1'	160°03.4'	22
487	8-8	62	13	10	33515.9	46199.6	56°24.4'	160°18.1'	8
488	8-8	65	17	10	33598.8	46347.2	56°17.6'	160°39.8'	7