Northwest and Alaska Fisheries Center Processed Report*

RESULTS OF AN INDUSTRY-GOVERNMENT JOINT VENTURE ON BERING SEA CLAMS, SEPTEMBER 1976

by

Steve Hughes

February 1977

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northwest and Alaska Fisheries Center
2725 Montlake Boulevard East
Seattle, Washington 98112

*This report does not constitute a publication and is for information only. All data herein are to be considered provisional.

NOTICE

RESULTS OF AN INDUSTRY-GOVERNMENT JOINT VENTURE ON BERING SEA CLAMS, SEPTEMBER 1976

by

Steve Hughes*

February 1977

*Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, 2725 Montlake Boulevard East, Seattle, Washington 98112.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Several factors prompted this jointly funded industry-government venture. Foremost is the current shortage of clam meats in the United States which is primarily due to the recent decline of the east coast surf clam fishery. A 50 percent reduction in clam meat supplies to about 50 million pounds in 1976 has resulted in substantial price increases since 1975. Species other than surf clams are being harvested in increasing numbers in an attempt to fill the gap, and food technologists are attempting to solve problems of "other species" market acceptance. Finally, considerations are being given to development of latent clam resources in areas other than the traditional east coast grounds. The Bering Sea is one area under strong consideration due to the presence of surf clams and several other commercially valuable species.

The Pacific west coast clam fishing industry is very small and deals primarily with butter clams, steamer clams, razor clams, horse clams, and geoducks. However, potentials for west coast and Alaska clam development and expansion are substantial, and ready markets exist. Thus, clam resources along the west coast and in the Bering Sea are of nation-wide interest. The 1976 joint industry-government venture, while very small scale, is an example of both east and west coast interests in Bering Sea clam resources since funds were contributed from both areas.

Objectives of this venture were to determine the species occurrence of clams in selected Bering Sea and adjacent bay areas, determine some index of their abundance, and collect samples for paralytic shellfish poisoning tests and food quality studies.

METHODS

Funds from industry and government permitted the charter of the 86-foot trawler/crabber Anna Marie for six and one half days and the purchase of clam sampling gear. The vessel charter was initiated in Dutch Harbor September 4, 1976. Clam sampling gear was installed and made operational prior to that date. This gear consisted of a set of "patent tongs" which open and close hydraulically with sufficient hydraulic hose to permit operations to a depth of about 18 fathoms. Such gear is successfully employed on the east coast for the commercial harvest of surf clams. The tongs are operated much like a grab, being lowered to the seabed in an open position by a cable. Once at rest, the opposing tongs are hydraulically closed, thereby penetrating the substrate and collecting available clams within the device.

Survey methods were exploratory in nature and conducted at depths of 3-18 fathoms in bays on Unalaska Island, and along the Bering Sea side of the Alaska peninsula between Urilia Bay on Unimak Island and Port Moller. Seabed hardness and profile was determined with a vertical sounder. When areas of soft, non-rock substrate were located, the vessel stopped, and the tongs were lowered for at least three successive grabs. Normally this procedure was continued along transects designed to cover depths of 3-18 fathoms. When possible, landings were made on beaches, shovel diggings were completed, and intertidal areas were examined for empty shells. Clams collected were identified by species, washed in sea water, and frozen immediately in the shell.

RESULTS

Vessel Surveys and Collections

Figures 1 and 2 summarize the areas covered and locations referred to in the text where live clams and or clam shells were obtained.

Makushin Bay (refer to Coast and Geodetic Survey (C&GS) chart No. 9023) is a large inlet located on the north coast of Unalaska Island. Its entrance faces west into the Bering Sea. This bay has about 50-55 miles of shoreline including four smaller bays--Anderson Bay, Cannery Bay, Portage Bay, and Humpback Bay.

Most of the Makushin Bay area is deeper than 50 fathoms, and very little area is less than 18 fathoms. Over 50 sets were completed in the head of Cannery Bay, along its north and south shorelines and on the east shore of Anderson Bay; another 10 sets were completed between Makushin and Cathedral points. In each area, live heart cockles (Clinocardium nuttalli) were obtained which averaged 4-1/2 inches across the shell. The largest catch was four clams in one sample (the tongs encompass a 12 square-foot area) taken in 6 fathoms of water directly east of the Makushin Church. Two species of Macoma, Macoma brota and Macoma nasuta, were also commonly obtained, especially in the soft mud substrates near the head of Cannery Bay. Surf clam shells measuring 5-1/2 to 6-1/2 inches across were obtained in all areas, but no live individuals were found. Much of the beach in Cannery Bay was covered with impressive quantities of butter clam (Saxidomus giganteus) shells measuring 4 to 5 inches across; however, no live specimens were obtained.

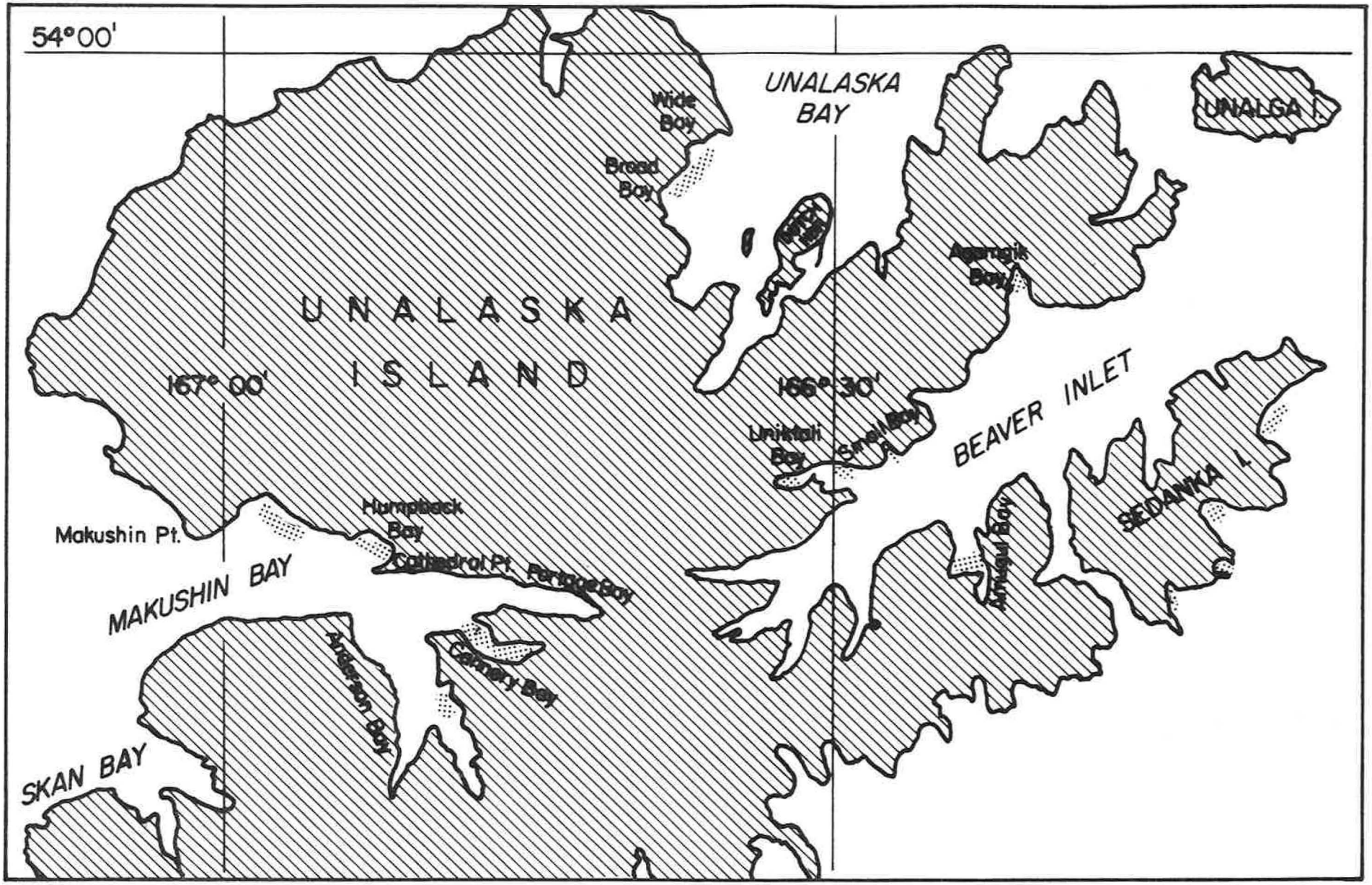

Figure 1. Selected areas near Unalaska Island, Alaska where clam sampling was conducted during September 1976. Stippled areas indicate where sampling was conducted.

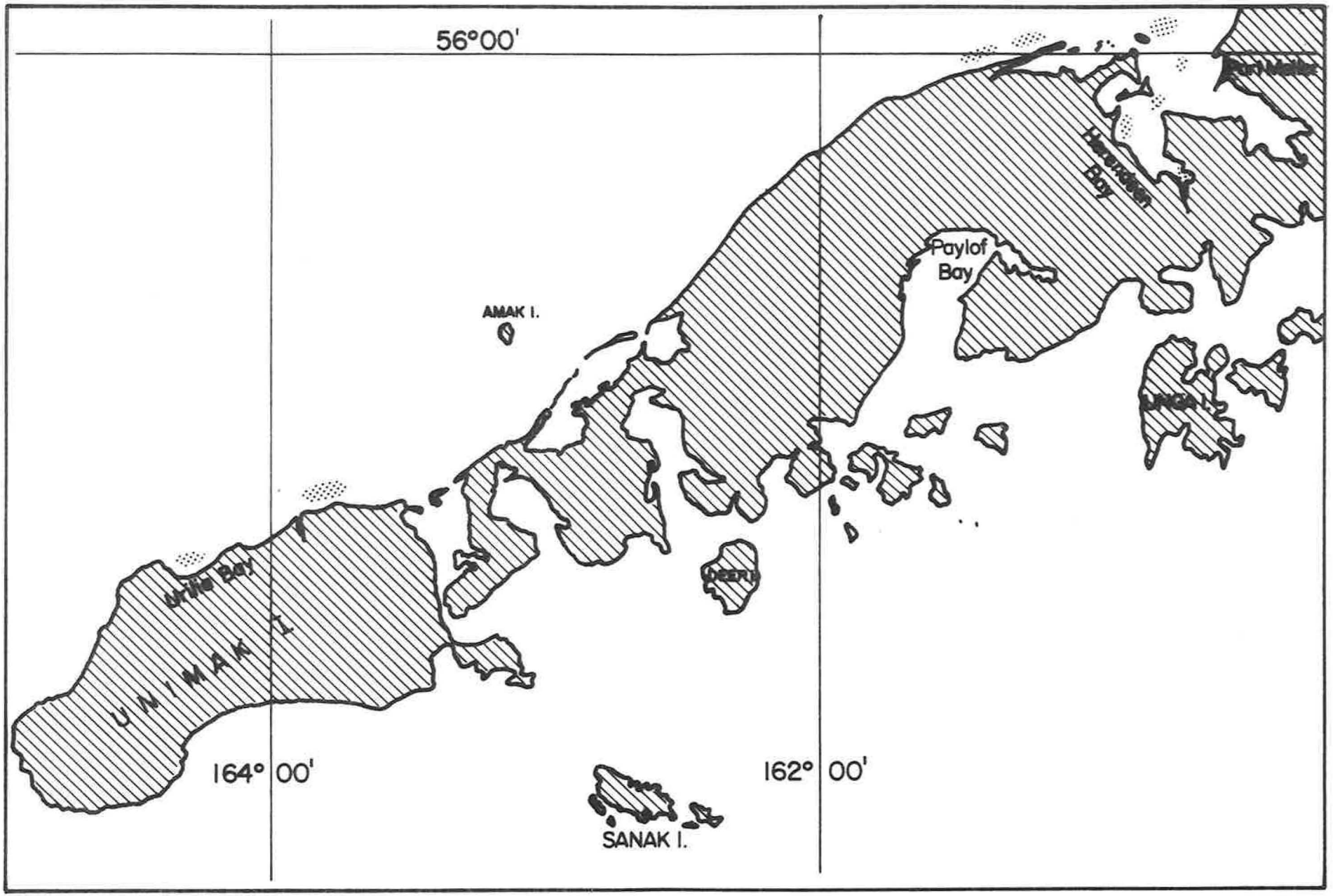

Figure 2. Selected areas between Unimak Island and Port Moller, Alaska where clam sampling was conducted during September 1976.
Stippled areas indicate where sampling was conducted.

Broad Bay and Wide Bay are located on the east shore of Unalaska Bay, Unalaska Island. Unalaska Bay opens northward into the Bering Sea, and both Broad and Wide Bays are exposed to surf action (see C&GS chart No. 9007). Heart cockles and juvenile surf clams were obtained in subtidal samples, and large numbers of heart cockle shells and adult surf clam shells were obtained on the beach areas. Heart cockles were large (4-1/2 inches), and the live juvenile surf clams measured about one inch across. Surf clam shells on the beaches were very common and usually of uniform size, being 5 to 6 inches across. Local residents near this area indicated that at extreme low tides they commonly dug "butter clams" in this area. However, no butter clam shells were located, and it is possible that their diggings were actually surf clams. Residents also indicated that cockles are common on most beaches in the area. These clams are eaten year round and have caused no ill effects.

Beaver Inlet (C&GS chart No. 9018) is a major waterway located on the east end of Unalaska Island. Twelve bays are located within the inlet; each is normally protected from direct surf action. Samples were collected in Agamgik Bay, Small Bay, Uniktali Bay, and Amugul Bay. Results were the same in each area, and live clams consisted only of heart cockles and bent nose clams. Surf clam shells were taken in all areas, and butter clam shells were obtained in gravel areas within Agamgik Bay. Soft mud substrates prevailed in the head of all bays, where fresh water influence was noted without exception. Other areas were of hard sand or gravel composition.

Sampling was also conducted in the four unnamed bays along the Pacific side of Sedanka Island, adjacent to Beaver Inlet. Each beach and subtidal

area is composed of hard-packed, white sand, and surf action is prevalent. No live clams or shells were obtained in these bays. Landings were made on two of the four beaches, and no evidence of clams was noted.

Near-shore areas of the Alaskan Peninsula between Unimak Island and Port Moller (C&GS chart No. 8802) were sounded in search of soft bottom. Search patterns were conducted at depths of 3 to 20 fathoms. Soft bottom exists from an area between Urilia Bay to a point 10 miles east of Amak Island and along a second area from a point 10 miles west of Port Moller to the entrance of Port Moller.

Numerous attempts to sample these soft areas with the tongs were unsuccessful. The sea bed consists of a hard-packed, fine-grained black sand. Numerous surf clam shells were obtained, but no live animals were collected.

Sampling was also conducted inside Port Moller (C&GS chart No. 8833) throughout Herendeen Bay. Substrates at the Bay's entrance consist of sticky mud. Samples collected indicated an oxygen-poor environment. Numerous grab samples produced 10 to 15 clams each. At the head of Herendeen Bay near Portage Creek, intertidal diggings were completed on several beaches. At these locations, the intertidal exposure is extensive, commonly being over one half mile from low tide to the drift zone. Soft shell clams, Mya arenaria, were located in all areas by shovel digging. The clam beds were crowded, and each shovel of substrate generally produced 10 to 20 clams. Drift zones in these areas were examined and commonly contained surf clam shells.

Results of PSP and Yield Tests (Standard Method of AOAC 18.073)

The shucked meats were homogenized in a blender. For extraction, 100 g. of the homogenized shellfish were mixed with 100 ml. of 0.IN-HCL, stirred, and the pH checked with a meter. All pH values were about 3.0. The mixture was heated, allowed to gently boil for 5 minutes, and then cooled to room temperature. The pH was rechecked to make sure it was between 2.0 to 4.0. A small portion of the mixture was transferred to a centrifuge tube and centrifuged for 5 minutes at 3000 rpm.

Each of three mice (method 18.075 AOAC) were injected intraperitonally with 1 ml of the supernatent from the centrifugal acid extract. Death time was taken as the time from innoculation to last gasping breath.

Data showing individual clam specimen weights, shell width, percent yield of meat and results of the PSP tests at each collection site are presented in Tables 1-3. Table 4 summarizes the data by species, showing average sizes and average tissue yields.

Results of Industry Product Quality Tests

Three participating industry members, New England Fish Company, Hood Canal Aqua Products, and Howard Johnson Corporation, assumed responsibility for evaluating the quality of various clam products. Results of their respective studies are indicated below.

Evaluation of Alaskan clams by Howard Johnson's.--We evaluated the samples of shellfish you sent us recently and a short summary follows.

(1) Clinocardium nuttallii.--The digging foot was cleaned, sliced and frozen, then battered, breaded, and fried for one minute at 375°F. The flavor was good, but more characteristic of squid than surf clams, and the texture was very chewy.

Table 1.--Size, weight, yield, and results of PSP tests on the cockle, Clinocardium nuttallii, obtained at depths of 18-36 feet from Broad Bay and Makushin Bay, Unalaska Island, Alaska.

Specimen No.	Weight in shell (g.)	Total weight of tissue (g.)	Shell width (cm.)	% yield of tissue	PSP + or -
Broad Bay, Unalaska					
PSP-1-1	296	112.3	8.64	37.94	-
PSP-1-2	515	230	11.6	44.7	+1/
PSP-1-3	433	166	11.7	38.3	-
Makushin Bay, Unalaska					
PSP-1-4	487	207	11.1	42.6	-
PSP-1-5	468	225	11.1	48.0	-
PSP-1-6	336	129	10.5	38.4	-

1/ Death times (113 minutes) exceeded table values for accurate assessment of presence of PSP. Shortest death time of the three mice was 85 minutes and the longest 127 minutes.

Table 2.--Size, weight, yield, and results of PSP tests on Macoma sp. obtained at depths of 3-72 feet in Herendeen Bay, Port Moller, Alaska.

Specimen No.	Total weight in shell (g.)	Tissue weight total (g.)	Shell width (cm.)	% yield of tissue	PSP + or - 1/
PSP-1-7	24.3	12.7	6.47	52.4	
PSP-1-8	27.5	12.5	6.75	45.5	
PSP-1-9	43.6	24.5	6.70	56.2	
PSP-1-10	40.4	24.0	6.70	59.4	
PSP-1-11	51.2	27.7	7.20	54.1	
PSP-1-12	37.7	19.7	7.30	52.3	

1/ All meats were pooled and extracted for PSP analysis. The resulting extract showed no toxicity.

Table 3.--Size, weight, yield, and results of PSP tests on the soft shell clam, *Mya arenaria*, obtained intertidally at Herendeen Bay, Port Moller, Alaska.

Specimen No.	Weight in shell (g.)	Weight of tissue (g.)	Shell width (cm.)	% yield of tissue	PSP + or - [1/]
1	58.8	31.4	7.50	53.4	
2	31.0	16.7	5.66	53.9	
3	27.1	14.9	5.59	55.0	
4	24.9	14.7	5.80	59.0	
5	19.3	11.4	4.88	59.1	
6	19.6	11.9	5.15	60.7	
7	19.2	11.7	5.29	60.9	
8	19.8	10.9	4.95	55.1	
9	16.9	9.5	5.00	56.2	
10	12.5	7.7	4.59	61.6	
11	13.0	7.3	4.39	56.2	
12	12.5	7.2	4.57	57.6	

[1/] Because of size, all the shucked meats were pooled and then extracted for PSP essay. No toxicity was observed in the pooled extract.

Table 4.--Average weight, size, and tissue yield from three species of clams obtained in the Bering Sea, Port Moller, and Unalaska Island, Alaska.

Species	Average whole weight in grams of clams	Average weight in grams of shucked tissue	Average shell size (cm.)	Average % yield of tissue
Clinocardium nutallii	422.3[1/]	178.2[2/]	10.8[3/]	41.7[3/]
Macoma, sp.	37.5[5/]	20.2[6/]	6.85[7/]	53.3[8/]
Mya arenaria	22.6[9/]	12.9[10/]	5.2[11/]	57.4[12/]

1/ s.d. = 87.6 (n = 6)

2/ s.d. = 50.2 (n = 6)

3/ s.d. = 1.13 (n = 6)

4/ s.d. = 4.20 (n = 6)

5/ s.d. = 10.1 (n = 6)

6/ s.d. = 6.40 (n = 6)

7/ s.d. = 0.33 (n = 6)

8/ s.d. = 4.70 (n = 6)

9/ s.d. = 12.6 (n = 12)

10/ s.d. = 6.60 (n = 12)

11/ s.d. = 0.84 (n = 12)

12/ s.d. = 2.80 (n = 12)

(2) Spisula polynyma--baby surf clams and adult surf or bar clams.--These clams compare favorably with the eastern surf clam Spisula solidissima in flavor and texture. They are smaller in size and more highly colored (darker orange). This would not present a problem in a breaded product, but might be noticeable in New England style clam chowder.

These clams were slightly more chewy and less sweet than our present supply of Virginia surf clams. We are very interested in this clam.

(3) Mya arenaria--soft shell or steamer clams.--Excellent flavor and appearance, but we feel the market appeal of these clams would be limited to New England where Ipswich style clams are popular.

As we discussed recently, I am looking forward to receiving about 25 pounds of large surf clams for presentation to Howard Johnson's management later this winter.

Evaluation of Alaskan clams conducted by New England Fish Company.--A clam survey was carried out last summer by the National Marine Fisheries Service in various parts of Alaska, and Nefco was one of several companies that received samples of the various species collected on the survey. The clams were evaluated in the research lab by Pete Harris, Ken Mleczewski, and Jim Barr. We prepared and examined the clams in several different ways, including boiled in the shell, eviscerated, and deep-fried with a batter coating, and retorted in a can. The four types we examined were cockles, soft shell clams (Mya arenaria), Macoma clams, and baby surf clams.

(1) Cockles.--The cockles were the largest of the clam samples we observed. With shell widths ranging from 3-1/4 to 4-3/4 inches, the

cockles had a very large meaty digging foot which we felt could be used in several different ways. When cut into strips, batter-coated, and deep-fat fried, the cockle digging foot yielded long, light-colored strips that had a good, mild clam flavor, but which were fairly chewy and tough. Diced and retorted, the cockle gave an excellent chopped clam product. The resulting meat was light tannish-orange in color and compared very favorably with a canned chopped clam product (presumably surf clams) purchased at retail.

The general feeling was that this clam has many potential advantages: used for strips (although the texture might be a concern); as a canned chopped clam product; and as an excellent source of clam meat for use in clam chowders. Its large size would make it easy to handle in processing, and the labor required per pound of clam meat would be lower than for some of the other species of clams examined.

(2) Soft shell clams--Mya arenaria.--These clams were much smaller than the cockles, with shell widths seldom exceeding 2-1/2 inches, and the shell being much flatter and shallower than the wide, deep cockles. When boiled in the shell, these clams had a very good, mild clam flavor. The same was true when the clams were battered and deep-fat fried--a good mild flavor, with the texture being chewy, but not tough. Because of the small size of the clams, strip cutting would not be practical, but the battering and frying of the entire clam body (after evisceration) shows promise. When canned and retorted, the soft shell clams turned to a light grayish color--quite a bit different from the standard orangish tan of the surf clam product.

This clam does not seem as adaptable to as many different uses as does the cockle, but that does not rule out its use in more specific product categories.

(3) Macoma clams.--The Macoma clams were larger than the soft shell, but smaller than the cockles. Being shallow--similar to the soft shell--the shell widths were between 2 and 3 inches. When the entire eviscerated clam body was battered and deep-fat fried, an excellent fried clam product resulted. It was superior to all others tested, when prepared this way. The flavor was excellent, and texture was chewy without being tough. In the boiled state, the Macoma had a good, mild clam flavor and acceptable texture. When this clam was canned and retorted, the meat was somewhat comparable to the cockle with a light tannish gray color. In this canned product, the broth was very comparable in flavor to the broth in the chopped surf clam sample; it had a sweet, mild clam flavor.

Overall, the Macoma clam has excellent potential for usage in clam products to be marketed in the U.S. From our cutting, it appeared that the battered and deep-fat fried version of this clam would gain excellent acceptance.

(4) Surf clams.--The surf clams we received were very small in size (baby clams)--less than 2 inches long at the widest part of the shell. Because of this limitation, it was quite difficult to make meaningful evaluations. One of the small clams was battered and fried, and it appeared to give a fairly good product, with good clam flavor. We were unable to make strips or chopped clam products from the small clams on hand, so the potential for those types of products remains unknown. The small individuals we examined had a purplish-violet coloration to portions

of the neck and foot parts. If this coloring exists in the mature clams, it could cause some difficulties.

This species still holds great interest, because if it is like the east coast surf clam and if it is available in large quantities as some people suspect, it could easily fit into many existing product categories. We are very eager to learn more about this clam and the future potential it represents.

Evaluation of Alaskan clams by Hood Canal Aqua Products, Inc.--The following is a summary regarding the experiments we performed on the Alaskan cockle clams.

The 10 clams were weighed and shucked, with a recovery of 19 percent edible meat, and 81 percent waste consisting of viscera and shell.

The recovered meat was processed and extruded as clam strips. We found the meat was of excellent quality and taste, and would be very satisfactory for our process.

CONCLUSIONS

The quantity of subtidal clam samples collected using the patent tongs was less than desired. No adult surf clams were obtained; however, the abundance of surf clam shells was impressive in many subtidal and intertidal areas. Collections of Macoma clams, M. brota and M. nasuta, the cockle, Clioncardium nuttallii, and the eastern soft shell clam, Mya arenaria, were sufficient to provide adequate samples for product quality tests and paralytic shellfish poisoning tests. Results of PSP tests were all negative, and the quality of all clams was desirable.

While results of this study have been encouraging, they further indicate that assessment of Bering Sea clam resources and collection of samples in sufficient volume will only be accomplished by use of hydraulic clam harvesters as employed along the east coast of the United States.