A REPORT ON THE FIELD INVESTIGATION INTO THE COMMERCIAL POTENTIAL OF THE PATAGONIAN SCALLOP, CHLAMYS SP. OF URUGUAY

Prepared for BIVAR S.A.
for
Presentation to the Uruguayan Government

by

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Executive Summary

BIVAR SA initiated exploratory fishing on a Patagonian scallop bed off the coast of Uruguay. Preliminary indications are that a fishery can be developed, initially on the scale of two to four small vessels. Careful monitoring of the fishery while it is being conducted, as well as additional explorations, will determine the long-term sustainability of the fishery. The economics dictate the need for a high quality product for the fishery to be viable. The average meat count of the scallops produced in this fishery may range somewhere between 185-222/kg (85-100/lb.) if small scallops and pieces are removed.

Introduction

Uruguay is located in the Southeast Atlantic Region of South America at approximately 35 degrees South and 55 degrees West between Argentina and Brazil. The marine environment of the coast is influenced by the Brazil and Malvinas currents as well as the discharge of the Rio de la Plata.

The marine fauna of Uruguay is both subtropical and subantartic in its species composition. These species support a fishery that in 1981 landed 147,000 tons. The primary landings include hake (Merluccius hubhsi), white croaker (Micropogon opercularis) and striped weakfish (Cynoscion striatus).

The current situation is that the three demersal species representing the bulk of the catch, listed above, may be fully, if not overly, exploited. Diversification of the fishery has been advocated as the next step for further development of the fishing industry (Medero and Abdala, 1986; Astori and Buxedus, 1986).

BIVAR SA has undertaken this preliminary investigation to determine if the company can develop and conduct an economically viable fishery on the Patagonian scallop. BIVAR is a Urguayan company headquartered in Montivedeo and with processing facilities on La Paloma. The company employs upwards of 100 people. BIVAR plans to specialize in high quality non-traditional seafood products for the export market. BIVAR is interested in developing high quality scallop products for export.

An initial series of tows, using a hake net, wa conducted by the B/P Maria Laura during March 1991 to locate a scallop bed and acquire scallops for evaluation (Table 1). This evaluation provided BIVAR with the incentive to take the next step of conducting this field investigation.

The investigation was divided into a number of tasks as follows:

1. Design, construct and test a sampling gear to catch Patagonian scallops,

2. Locate and estimate size of at least one substantial bed of Patagonian scallops,

3. Determine the most appropriate methods to harvest and handle the catch at sea,

4. Develop a methodology for processing and packaging the scallop product,

5. Collect data including scallop population length frequencies and shell/meat relationships.

Gear Design

The initial series of tows by the B/P Maria Laura indicated that the scallop could be caught by fishing nets, the shells were very fragile and averaged approximately 70 mm in shell length when of commercial size. The bottom on which the scallops were located was flat and without rocks or other net obstructions.

For these reasons the choice was made to use a North Atlantic sea scallop trawl design for the sampling gear instead of a dredge. An additional reason was the exploratory vessel, the B/P Maria Laura was rigged and proficient for handling a net versus a dredge.

The scallop sampling net design and construction was based on material and equipment readily available at the BIVAR plant in La Paloma. The trawl was constructed with identical top and bottom sections using a headrope (cuerda de boya) and footrope (burlon) of 17m length. Mesh sizes of 120mm were used in the wings (ala), 100 mm in the belly (betti) and 80mm in the extension (tunnel) and cod end (bolsa). The cod end was covered all around with a large mesh chafer (forro).

The doors (portones) were French made steel ovals measuring 160cm by 95cm and weighing 180kg each. The net was rigged with 2.5m bridles (bridas) and 6.5m groundwires (patentes).

A Texas drop chain sweep was used constructed of 13mm diameter chain, 16m in length, and attached to the footrope (a rope-wrapped 18mm diameter steel wire) with 8mm diameter drop chains, 24cm in length, at 70cm intervals.

Gear Operational Tests

The B/P Maria Laura began the field trials on March 28, 1991 at the location she previously caught scallops. A short tow was made using the vessel's hake net (Table 2, Tow 0) catching one box of hake and about 100 boxes of bycatch fish species. Less than 1/8 box of scallops was caught.

This was followed by a series of sixteen tows with the scallop

trawl in which the net was adjusted and fishing operations tuned. Final adjustments included a towing speed of 3 knots, a warp scope of 4 to 1 (trawl warp length to depth ratio), shortening the chain sweep to 15m, increasing lower bridle length by 25cm, and reducing headrope floatation from eleven to seven floats (boya).

These changes increased the bottom scraping action of the trawl, to increase scallop catch, and lowered the headrope height to minimize fish catch. The crew was trained on how to examine the trawl sweep to determine it is operating correctly.

Scallop Bed Location and Size

A portion of a scallop bed was defined by a series of fifty tows presented in Table 2. The past surveyed runs from a southern position of about 36 degrees 50' S to a northern position of 36 degrees 10' S between the depths of 80 to 86 meters. The bed may in fact be more extensive to the north and south as well as deeper depths but time limitations prevented further explorations. The scallops do not show up at all in the tows conducted at depths less than 80m.

A conservative estimate of the portion of the bed surveyed would be that it is at least 40 nautical miles in length and 3 miles in width (between the 83-86 m depth contours) for a total area of 120 square miles.

Scallop catch rates, when the survey net was fishing properly (but at an unknown efficiency), averaged about 20 boxes per tow (boxes are 45cm X 67cm X 15cm). It should be noted that the trawl, in all probability, significantly underestimated the standing stock of harvestable scallops because of the large mesh size, 120mm, and rough weather during many of the tows.

The tows were approximately 30 minutes in duration at speeds of about 3 knots. Measurements on deck of trawl warp angles and knowledge of net mechanics would indicate a maximum swept width of 15 meters. Using these parameters a yield of 20 boxes of scallops was obtained from a swept area calculated as follows:

30 minutes @ 3 knots = 1.5 nautical miles or 2745m

Length X width = 2745 X 15 = 41175 square miles

Using 1830m to one nautical mile the total scallop bed area surveyed in roughly 401,870,000 square meters.

This yields a crude approximation of potential harvest from this standing stock of the area surveyed of 195,200 boxes. It must be noted that this survey was not intended to be conducted in a random or systemized manner that could yield statistically validized results.

Harvesting and Handling

There were several problem areas identified in the harvesting and handling of these scallops. These areas are scallop shell breakage, substrate mixed in with the catch, and fish by-catch.

The scallop breakage problems consisted primarily of the crushing of the fragile shell. While it is possible that this breakage can take place during the tow, such as the cod end, it is most assuredly taking place in bringing the catch onboard. Impact between the cod end and the vessel deck, railings, etc. was observed to cause crushing. Crew members, use to walking through deck loads of fish, caused crushing damage while picking the catch.

The breakage problem was significantly instigated by reducing the catch volume (shorter tow times), increasing care in bringing the cod end onboard, and training the crew not to abuse the scallops while picking.

Many of the scallop shells were heavily fouled by a variety of marine organisms including sponges, worm tubes of several types, mussels, anenomes and a brown algae. Fouling on larger scallops (70-80mm) appeared to cause damage on the outer edge of the shell. The edge of the shell was easily broken and could possibly be a significant cause of natural mortality.

Scallops greater than 80mm were uncommon. Observations of the

growth rings on the outer edge of the shell indicate that growth beyond 70mm is a slow process. On many scallops 3-4 growth rings accounted for less than 5mm in total shell size. The occurrence of many slow-growing large individuals is a common observation for unfished virgin populations. These observations and conclusions are based on the assumption that the observed rings do indeed represent annual formations.

The problem of substrate in the cod end may be more significant with the B/P Maria Laura than other vessels. This vessel must disengage its propeller to use the winches thus basically dragging the net slowly over the bottom. This has been observed to cause excessive substrate in the cod end based on past experiences in other fisheries.

This problem was addressed by having the vessel steam ahead at five or more knots with the cod end trailing astern. This washing of the catch for a few minutes in most cases significantly reduced the substrate content of the cod end. The boxes of picked scallops were also washed with the deck hose before being placed in the hold.

Fish by catch, consisting of electric rays, rosefish, skate, dogfish, popamosca and hake, made picking and sorting the catch time-consuming. The bycatch is relatively insignificant in volume, usually less than the scallop catch, but still will cause a slight handling problem in a commercial scale operation.

Most of the bycatch can probably be reduced with fish escape devices of one type or another. The most difficult species to address will be the electric rays but all in all the fish bycatch problem is not significant.

It may be desirable to sort out the smaller scallops before boxing and return them to the sea. This should be relatively easy to accomplish by crew training and/or use of a sorting table.

The system of boxing the scallops, washing with the deck hose, and placing ice on top seems to work well. The boxes were filled three quarters with scallops and one quarter with ice. Marking the boxes in some way to designed when captured would be useful for deciding the processing order ashore at the plant.

Processing

Upon unloading and arrival at the plant the scallops were kept in refrigerated storage at 2 degrees C. There was still sufficient ice in most boxes but additional ice was added to boxes at the top of each stack as needed.

Scallop shucking knives were constructed and customized for these particular scallops. Twenty shuckers were training and placed onto a production line. Within 8 hours of shucking experience some of the individual shuckers were able to process one box of scallops every 45 minutes. The yield from a box of scallops is about 1.4 kg of meats.

The broken and smashed scallops, for the most part, are capable of being shucked. One problem is these scallops, as well as the unbroken, is the presence of sand grit. Special attention was paid to the washing of the final product before freezing.

Twenty boxes of shucked scallops were taken from the production line from four of the best shuckers and the meat yield resulted presented in Table 4. A box, on average, contained 1.336kg of meats from 299 scallops. The individual meats averaged 4.47 grams yielding a meat count of 225/kg or 102/lbs.

Data Collection

Shell length frequencies were taken at sea after six tows (Table 3). In addition very small scallop spat was observed on shell debris caught in the net.

One box of shell stock was selected at random and measured in 5mm increments in each of five tows and a partially filled box on a sixth tow. Total number of scallops measured was 1825. The range was from 35-80mm with a peak at 65-70mm. Only a few individuals over 80mm were observed in the entire catch.

The spat found attached to old scallop shells measured from 1 to 10mm. Scallops were also observed in the catch that were from 20 to 35mm in length.

Shell length to meat weight data can be found in Table 5 based

on 575 scallops between 55-76mm in shell height. Additional samples were taken but have not been tabulated at this time.

Conclusions and Recommendations

1. There is an untapped standing stock of scallops in Uruguayan waters that certainly should be able to sustain a small fishery. The extent of the stock and degree of fishing pressure it can ultimately sustain is an unknown.

2. The development of this fishery should proceed on a conservative basis. A limited fishery consisting of two to four vessels should be development possibly using chartered vessels. These vessels should be about 20-25m in length, double rigged trawlers, with a hold capacity of 3000 boxes, crew size of about eight, and a 7 day endurance. The vessels should be capable of shifting to other similar trawl fisheries, such as flounders, if needed on a seasonal basis.

3. The fishing operations should be designed around many short small hauls as opposed to fewer but larger hauls. Scallops smaller than 55mm should be returned to the sea. A mesh

size between 80-100mm may be appropriate.

4. BIVAR should routinely collect information about the fishery including shell length frequencies, meat count, catch per unit effort, and bycatch. It is suggested that underwater video equipment be utilized to observe the scallop grounds for incidental fishery related damage. A small electronic balance (500 gram capacity) and a desktop computer should be purchased for the La Paloma plant for data collection and analysis.

5. Once the fishery begins and proves itself to be economically viable development efforts should focus on locating new beds of scallops, improving fish separation in the trawls, designing on deck sorting equipment, and product quality and value improvements.

6. Processing must proceed at a rapid pace. The catch needs to be processed within three working days of arrival at the plant. All grit must be removed from the final product before freezing.

7. Stock assessments and monitoring could be

accomplished with the use of a 2m scallop dredge of either the Australian cage design or the Canadian green-sweep design. A major advance of a dredge versus a net for stock assessments is that a dredge is easier to standardize to determine catch rates.

8. The use of a scallop dredge to harvest scallop resource should not be discounted at this time. A dredge of appropriate design may be more effective in minimizing breakage, fish by-catch and in the long-run, be more cost efficient for small boat fishing operations. The northern most areas, which may contain scallops, were considered untowable by the B/P Maria Laura Captain using a trawl.

9. The use of a split cod end may be beneficial in the trawl to minimize breakage and provide some degree of fish separation. Future net fishing operations should try a net with a horizontal panel in the cod end with two cod end ropes.

References

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LANCE Nº	HORA	LAT.	LONG.	PROF.	RV.	FILADO	VELOC	RPM	VIEIRA	MERLUZA	OBSERVACIONES
1	06 40	36°49,5	54°59,5	6.2	030	350	2,5	1320	—	—	
	07 10	36°46.0	54°57,0	—	—	—	2,4	—			
2	08 25	36°47,0	54°50,0	74	030	350	2,4	1300	—	—	
	09 05	36°45,0	54°48,0	69	—	—	2,0	—			
3	10.30	36°42,0	54°36,0	80	040	400	2,1	1300	4 1/2	8	
	11.30	36°38,0	54°31,0	83	—	—	—	—			
4	12.15	36°38,0	54°30,5	83	220	400	2,0	1300	2	2	
	13.15	36°40,0	54°33,5	82	—	—	—	—			
5	13 55	36°37,5	54°32,0	83	060	400	1,8	1300	4	4	
	15.05	36°37,0	54°28,0	84	—	—		—			
6	16.00	36°36,5	54°30,0	79	020	400	2,5	1300	2 1/2	2	
	17.10	36°33,5	54°26,5	81	045	—	3,1	1420			
7	18.10	36°36.0	54°28,0	83	220	400	2,8	1450	3	2	
	19 10	36°39.0	54°30,0	83	—	—	—	—			
8	19 50	36°37.0	54°31.0	83	230	400	2,8	1450	10	4	
	20.50	36°42.0	54°36.0	82	—	—	—	—			
9	21 30	36°42.0	54°36,0	82	220	400	2,8	1450	12	7	
	22 35	36°45,0	54°33.0	81	—	—	—	—			
10	23 10	36°44,0	54°38,5	81,5	030	400	3,0	1450	4	7	
	00.40	36°37,5	54°34,0	80,5	—	—	2,8	—			
11.	01 15	36°39,5	54°33,0	81,5	050	400	2,8	1450	1 1/2	4	
	02 25	36°37,0	54°29.0	83,5	—	—	2,5	—			

EXPERIENCIA REALIZADA POR EL BUQUE PESQUERO "MARIA LAURA" EL DIA 8/3/91, CON ARTES DE PESCA CONVENCIONALES.

TABLE 1

	HORA	LAT.	LONG.	PROF.	R.V.	FILADO	VELOC.	R.P.M.	BOLSAS	VIETRA	OTROS	OBSERVACIONES
	15.10	36°09,6	54°30,3	83,0	240	350	3,5	1380	1 1/2	1/8	95% P.P.M MERLUZA Y FONDO 5%	EQUIPO NORMAL DEL BARCO. AP. PORTONES = 94 MTS —
	15.45	36°40,7	54°33,4	82,8	—	—	—	—				
	18.35	36°40,9	54°34,4	81,0	225	250	4,0	1000	3/4	1/8	95 % P.P.M Y FONDO	RED N° 1 ESPECIFICA AP. PORTONES : 18,50 MTS. —
	18.50	36°41,7	54°35,4	81,3	—	—	—	—				
	19.20	36°42,0	54°37,0	80,3	205	300	3,8	980	3/4	1/2	— " —	
	19.35	36°43,5	54°38,3	81,3	—	—	—	—				
	20.25	36°44,0	54°37,0	83,0	220	300	3,8	980	3/4	1 1/4	90% FDO	
	20.55	36°46,0	54°39,5	83,0	—	—	3,6	—				
—	21.30	36°45,1	54°38,6	83,2	230	300	3,8	980	1/2	1 1/2	90% FONDO	
	22.00	36°46,7	54°40,3	83,2	—	—	3,6	—				
	22.25	36°47,4	54°41,1	83,4	220	300	3,4	920	1/2	—	90% FDO.	AP. PORTONES - 21 - MTS.
	22.55	36°48,5	54°42,3	83,2	—	—	3,0	—				
7	03.10	36°50,0	55°17,0	53,2	000	200	3,0	1020	1/4	— (3 CAJAS MEJILLON)	90% FDO RAYAS, ETC.	ALGUN LENGUADO MEDIANO
	03.40	36°48,5	55°16,0	51,6	040	—	—	1050				
7	05.00	36°48,0	55°10,0	57,3	000	200	3,0	1050	1/4	— (3 CAJAS MEJILLON)	— " —	
	05.30	36°46,5	55°10,0	54,6	—	—	—	—				
1	09.00	36°44,0	54°46,8	68,8	030	250	3,0	1000	1/2	—	— " —	
	09.30	36°43,0	54°45,2	68,2	—	—	—	—				
0	10.45	36°42,0	54°36,0	81,8	040	300	3,0	1000	3/4	1	— " —	
	11.15	36°41,0	54°34,0	81,9	—	—	—	—				
1	12.10	36°40,0	54°32,6	82,8	060	300	3,0	1000	1/4	1/8	50% RUBIO 40% FONDO	
.	12.40	36°39,1	54°30,7	83,3	—	—	—	—				
2	13.10	36°38,7	54°29,4	83,8	060	300	3,0	1000	1/4	1/4	— " —	
	13.40	36°37,5	54°28,3	84,9	—	—	—	—				
3	14.05	36°37,1	54°28,5	83,2	300	300	3,2	1000	1/4	1/8	— " —	
	14.35	36°36,0	54°30,5	79,0	—	—	—	—				
4	15.05	36°35,4	54°31,0	77,2	300	300	3,2	1000	1/2	—	95 % FONDO	

TABLA 2

	HORA	LAT	LONG	PROF	R.V.	PLOMADA	VELOC	RPM	SONDA	OTTER	OTROS	
15	16.00	36°34,3	54°31,0	73,5	080	300	3,2	1000	1/4	—	PONDO, RAYAS CANUTOS Y ALGUN PEZ	
	16 30	36°34,0	54°28,8	74,5	—	—	2,9	1000				
16	17.15	36°34,0	54°24,0	80.5	070	300	3.0	1000	1/4	1/2	— · —	
	17.45	36°32,0	54°22,0	85,1	050	—	—	—				
17	18.00	36°32.0	54°21,4	82,1	030	300	3,0	1000	1/4	1/2	— · —	
	1830	36°30,0	54°20,0	83,1	—	—	—	—				
18	19.10	36°30,6	54°21.0	83,2	035	300	3.0	1000	1/2	17	POCO FONDO Y ALGUN PEZ.	SE TOMAN 2 ESLABONES POR BANDA DEL DESPERTADOR Y SE AGREGAN 30 Kgs + EN COMBINADO
	1940	36°29,3	54°19,8	83,3	040	—	—	—				
19	20.50	36°28,9	54°18,3	83,3	045	300	3.0	1000	1	15	40% RAYAS Y FONDO	
	21.50	36°26,3	54°15,5	83,7	035	—	—	—				
20	22.15	36°26,8	54°16,8	82.5	220	300	3.0	1000	1/2	11	— · —	
	22.55	36°28,9	54°17,9	83.5	225	—	—	—				
21	23.20	36°29,3	54°18,6	83.3	250	300	3.0	1000	1/4	7	— · —	
	23 50	36°30,5	54°21.0	82.8	220	—	—	—				
22	05.20	36°40,5	54°34 0	82.3	050	300	3.0	1000	1/2	11		
	05.55	36°40,0	54°33 0	83 1	—	—	—	—				
23	06 25	36°40,0	54°33 0	83 0	035	300	3.0	990	3/4	11		CORRIENTE AL NE + - 0.6 NUDOS
	0655	36°38.0	54°28.0	83 4	—	—	—	—				
24	07 20	36°37,6	54°29.0	83.4	035	300	3.0	950	3/4	10		
	0755	36°36.0	54°27.0	82.4	—	—	—	—				
25	0825	36°35.0	54°27 0	82.8	035	300	2.9	950	3/4	10		
	0900	36°33 0	54°25.0	81.6	—	—	—	—				
26	0925	36°33 0	54°24.0	82. 7	045	300	2.9	1000	1/2	8		
	09.55	36°32 0	54°22.0	84,1	040	—	—	—				
27	10.25	36°31 0	54°22. 0	84. 1	040	300	2 9	1000	1/4	3		CORRIENTE AL N + - 1.0 NUDO
	11.00	36°29 0	54°20. 0	83 1.	—	—	—	—				
28	11 35	36°27. 0	54°19 0	83 5	030	300	3 0	1000	1	30		SE TOMAN 2 ESLABONES + AL DESPERTADOR
	12.15	36°21 0	54°16 0	83.4	—	—	3 5	—				

	HORA	LAT.	LONG.	PROF.	R.V.	FILADU	VELOC.	R.P.M	BOLSAS	VIEIRA	OTROS	OBSERVACIONES
	12.10	36°26,0	54°15,8	83.2	030	300	3,4	1000	1	27		
	13.25	36°23.7	54°14.1.	83 0	040	—	3, 2	—				
	14.10	36°22.0	54°12,1	84.0	030	300	3, 2	1000	3/4	13		
	14.40	36°20,2	54°08,8	82.0	040	—	3, 0	—				
	15.20	36°19,3	54°07,4	82.0	000	300	3, 2	1000	1/2	7		
	15.50	36°17,5	54°06,8	79, 8	—	—	3, 2	—				
	16 15	36°16,8	54°05,3	80. 0	025	300	3, 2	1000	1/4	—		
	16.45	36°15,3	54°03,7	80, 1	035	—	3, 0	—				
	17.25	36°14.0	54°00. 0	81 9	070	300	3. 0	1.000	1/4	11		
	18.00	36°13. 0	53°57.0	83, 7	—	—	—	—				
	18.30	36°12,0	53°57.0	84.4	040	300	3. 0	1000	1/4	3		
	19 00	36°10,0	53°56,0	82.1	—	—	—	—				
	20 20	36°09. 0	53°54,4	82, 8	045	300	3, 0	1000	1/4	2		
	20.50	36°08,0	53°53,0	83. 2	035	—	3. 0	—				
	21.20	36°07, 3	53°51,4	86. 2	080	300	3. 0	1000	1/4	1		
	21.50	36°05, 9	53°50,4	83. 4	025	—	—	—				
	04.15	36°30,7	54°19,4	83. 7	040	300	3. 0	1000	3/4	24		
	0445	36°29.0	54°18,0	82,4	—	—	—	—				
	05.15	36°25,6	54°15,8	84, 4	030	300	3. 0	1000	1	28		
	05.45	36°24.0	54°14,5	84,3	—	—	—	—				
	06 15	36°24,0	54°15,0	84,7	210	300	3. 0	1050	1	30		
	06.50	36°25,2	54°15,0	84.3.	200	—	—	—				
	07.20	36°26.0	54°15,0	85,3	200	300	3.0	1050	1	23.		
	07.55	36°28,0	54°15,0	85,7	—	—	—	—				
	08.50	36°29.0	54°18. 0	84.7	210	300	3. 0	1100	1/4	9		
	09.15	36°30.0	54°20.0	83, 3.	—	—	—	—				
	09 45	36°30,0	54°20,0	84, 5	180	300	3.0	1050	—	—		SE CRUZAN PORTONES.
	10 15			84 3	—	—	—	—				

	HORA	LAT.	LONG.	PROF.	R.V.	FILADO	VELOC	R.P.M.	BOLSAS	CAPTURA	OTROS	OBSERVACIONES
3	11.30	36°30.0	54°20,0	82,3	050	300	3.0	1000	1	26		
	12.10	36°27.0	54°16.0	83,1	—	—	—	—				
4	12.50	36°27,1	54°15,2	84,7	060	300	3.0	1000	3/4	21		
	13.20	36°25,8	54°13,5	85,2	—	—	—	—				
5	14.05	36°25,8	54°13,0	87,4	060	300	3.0	1000	3/4	20		
	14.35	36°24,5	54°11.5	85,7	020	—	—	—				
16	15.05	36°24.7	54°12,3	86,2	210	300	2.8	1000	3/4	17		
	15.35	36°25,7	54°13,2	86,8	—	—	—	—				
17	16.05	36°25,7	54°13,5	85,8	215	300	2.6	1050	3/4	17		
	16 35	36°26,8	54°14.2	85,3	—	—	2.2	—				
18	17.00	36°26,8	54°14,9	85.0	215	300	2 6	1050	3/4	18		
	17 30	36°27,6	54°15,0	84,0	—	—	—	—				
19	17.55	36°28,0	54°15,0	84,9	210	300	3.2	1000	3/4	18		
	18.35	36°28,8	54°16,0	85,8	—	—	—	—				
50	19.05	36°28,0	54°16,0	83,5	045	300	3.2	1000	1	20		
	19.35	36°25,8	54°13,0	83,6	—	—	—	—				
21.	20.10	36°24,2	54°11,7	84,7	050	300	3.0	1000	1	21		
	20,45	36°22,0	54°11,3	83,5	—	—	—	—				

Table 3. Shell Length Frequency Distributions of Patagonian Scallops Collected During Exploratory Fishing Off Uruguay.

Height Range (mm)	Tow Number #3	#11 & 12*	#22	#27	#29	#45	TOTAL
35-40				1			1
40-45	2			4		1	7
45-50	2	1		1		6	10
50-55	20	3	3	16		15	57
55-60	22	21	14	52	10	47	166
60-65	110	25	50	84	62	106	437
65-70	93	63	129	109	129	131	654
70-75	64	50	103	46	101	67	431
75-80	16	19	15	1	6	4	62
TOTALS	329	182	314	314	308	377	1,825

*Not a full box.

Table 4. Scallop Meat Yield Based on Box Sampling

Sample	Box Weight (gm)	Scallop #	Average Weight (gm)	Average Meat Count #/kg	#/lb.
1	1421.0				
2	1361.9				
3	1247.3				
4	1335.7				
5	1402.4				
6	1418.5				
7	1542.7				
8	1351.2				
9	1472.5				
10	1378.5				
11	1285.0				
12	1370.7				
13	1214.3				
14	1390.1	302	4.603	217	99
15	1393.5	309	4.509	222	101
16	1356.9	301	4.508	222	101
17	1401.2	290	4.832	207	94
18	1442.6	312	4.624	216	98
19	1227.7	288	4.263	235	107
20	1143.9	290	3.944	254	115
Meax (x)	1336.23	299	4.469	225	102

Table 5. Shell Height to Meat Weight Relationship

Shell Height (mm)	Sample Size (n)	Mean Weight (x) gms	--COUNT--- #/kg	#/lb	--SAMPLE-- Dev.	Var.	POPULATION Dev.	Var.
55	10	2.87	348	158	0.5982	0.3578	0.5675	0.3221
56	10	2.90	345	157	0.7831	0.6133	0.7429	0.5520
57	12	2.93	341	155	1.1006	1.2115	1.0538	1.1105
58	11	3.41	293	133	1.0746	1.1549	1.0246	1.0500
59	16	3.38	296	134	0.5022	0.2523	0.4863	0.2365
60	20	3.69	271	123	0.6568	0.4314	0.6402	0.4099
61	13	4.02	249	113	0.9705	0.9419	0.9324	0.8694
62	21	3.92	255	116	1.0063	1.0126	0.9820	0.9644
63	34	3.99	251	114	0.9443	0.8917	0.9303	0.8655
64	33	4.18	239	109	0.6924	0.4794	0.6818	0.4649
65	46	4.37	229	104	0.8111	0.6578	0.8022	0.6435
66	39	4.51	222	101	0.9380	0.8799	0.9259	0.8573
67	45	4.91	204	93	0.8532	0.7280	0.8437	0.7118
68	48	4.95	202	92	1.0571	1.1174	1.0460	1.0941
69	46	5.12	195	89	0.8455	0.7149	0.8363	0.6993
70	53	5.44	184	84	0.9528	0.9078	0.9437	0.8907
71	28	5.40	185	84	0.9317	0.8681	0.9149	0.8371
72	31	5.94	168	77	0.8523	0.7264	0.8384	0.7030
73	26	5.90	169	77	0.7975	0.6360	0.7820	0.6115
74	18	5.78	173	79	1.2458	1.5520	1.2107	1.4658
75	10	6.27	159	72	1.1662	1.3600	1.1064	1.2240
76	5	6.38	157	71	0.9093	0.8270	0.8134	0.6616
77								
78								
79								
TOTAL	575							