# **ASSESSMENT OF** NORTHUMBERLAND STRAIT SCALLOP STOCKS - 1980

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#### ABSTRACT

## Jamieson, G.S., N.B. Witherspoon and M.J. Lundy. 1981. Assessment of Northumberland Strait scallop stocks -1980. Can. Tech. Rep. Fish. Aquat. Sci. 1017: iv + 44 p.

Scallop stock assessments are presented for each of the three regions of Northumberland Strait. Resource surveys confirmed relatively low recruitment in recent years in the western Strait, resulting in the temporary establishment of a year-round scallop fishing closure zone in part of this region. The closed area also contains high densities of one-year-old scallops, an age class rarely fished with survey gear. Benefits hoped to be achieved from the closure zone are preservation of adult stock to facilitate possible future recruitment, and protection of prerecruits until they reach a size approaching optimal yield per recruit.

Relative age class frequencies in the other two regions showed no similar recent decline in recruitment, but overall abundance is still historically low and little evidence of age one scallops existed. Overall scallop landings decreased slightly in 1980, although both CPUE and price increased.

#### RÉSUMÉ

Jamieson, G.S., N.B. Witherspoon and M.J. Lundy. 1981. Assessment of Northumberland Strait scallop stocks -1980. Can. Tech. Rep. Fish. Aquat. Sci. 1017: iv + 44 p.

Le texte qui suit contient des évaluations de stocks de pètoncles pour chaucune des trois régions du détroit de Northumberland. Les relevés confirment un recrutement relativement faible ces dernières années dans le secteur ouest du détroit, ce qui a conduit à une interdiction, pendant toute l'année, de la pêche des pétoncles dans ce secteur. Il y a de plus dans cette zone fermée une forte densité de pétoncles âgés d'un an, une classe d'âge qui n'avait pas encore été pêchée en quantité avec les engins normalement utilisés dans la relevés. On espète assurer la conservation du stock adulte, afin de faciliter le recrutement futur et de protéger les prérecrues jusqu'à ce qu'elles atteignent une taille qui se rapproche du rendement optimal par recrue.

Dans les deux autres régions, la fréquence relative des classes d'agé ne montre pas de déclin récent semblable du recrutement, mais dans l'ensemble l'abondance est encore historiquement faible et on a observé très peu de signes de l'existence de pétoncles d'âge un.

Les débarquements globaux de pétoncles diminuèrent légèrement en 1980, en dépit du fait que les PUE et les prix augmentèrent tous deux.

#### INTRODUCTION

Scallop fishery data for management purposes is meagre prior to 1979 (Jamieson, 1979), the first year in which a scallop stock assessment was carried out based on stock abundance at age, CPUE and fishery performance (Jamieson et al., 1981). This report presents a follow-up assessment based on the age-frequency distribution and CPUE a year later, and evaluates the relative performances of mud and rock drags in Northumberland Strait stock assessments. The number of fishermen actively participating in the Northumberland Strait scallop fishery is estimated, and the types and sizes of gear used are described.

The Northumberland Strait scallop fishery is still at the historically low annual landing level of about 200 t of adductor muscle (meat) (Fig. 1). Recently, positive efforts have been made by fishermen through the Northumberland Strait Scallop Advisory Committee to optimize management of the fishery. From a state of no management a few years ago, management policy affecting license acquisition, scallop fishing seasons, allowable meat count per unit weight at landing, scallop log reports, and scallop closure zones were approved at the regional level (Table 1), and are anticipated to be in regulation by the beginning of the 1981 fishing season.

#### METHODS

#### A. Resource Surveys

Resource surveys were undertaken in all three regions of Northumberland Strait (Fig. 2; Jamieson et al., 1981) in 1980. In the western Strait, two surveys (Fig. 2) were conducted between April 23 and May 3 as a result of concern that the 1979 survey (Jamieson et al., 1981) in this region did not describe the age frequency distribution of scallops. The virtual absence in 1979 of scallops less than age eight in the areas of greatest productivity raised concern that stock collapse was imminent, and so to achieve a definitive statement, survey vessels were chartered out of both New Brunswick (M/V GMV; Capt. Maxine Vatour) and Prince Edward Island (M/V Angela S.; Capt. Tony Sharpe). The percent value of the total scallop catch landed from each area (Fig. 4; Jamieson et al., 1981) in 1979 was used to assign each area (Figs. 8 and 9) where scallops were fished to one of three survey strata: high, medium and low scallop yielding areas (Table 2). As in 1979, stations were randomly assigned to fishing areas and

since the total number of areas within a stratum sometimes exceeded the number of stations, not all fishing areas necessarily had stations. Within an area, stations were located randomly to an accuracy in seconds of longitude and latitude. This is in contrast to the cruder method used in 1979 (Jamieson et al., 1981), which divided each area into 100 discrete points and then randomly assigned station locations to these points only. One hundred stations were initially assigned for each charter, but because of time constraints, only 66 and 69 stations were completed by the New Brunswick and P.E.I. charters respectively.

In the central Strait, a survey commenced on July 9 (M/V Caspen Anchor No. 1; Capt. Henry Stright) and 60 stations (Fig. 3) were completed. In the eastern Strait, the survey commenced on September 8 (M/V Sue and Bert; Capt. Daniel Elliot), but owing to prolonged strong winds, only 19 stations (Fig. 4) could be completed in the two weeks allocated for the charter.

In the central and eastern regions of the Strait, assignment of areas to strata utilized only the 1980 scallop log data available at the time of the survey, with subsequent station location within a stratum determined as above.

Navigation was greatly improved over the procedure used in 1979, which involved dead-reckoning and water depth, because of the introduction of Loran C into this region in late winter, 1980. On each charter, an Internav 123 receiver and CC2 coordinate converter (Internav Ltd., Sydney, N.S.) allowed precise calculation of location at both the beginning and end of tow. In the, western Strait, P.E.I. charter, dead-reckoning and depth, as in 1979, were used to establish station location. Since actual distance sampled was unknown in this latter survey, this data has been analyzed separately.

In all surveys, the survey gear was a four-gang drag (Fig. 5) consisting of two 61 cm mud (chain sweep) drags (18 cm high entrance) in the centre, one of which was lined with 38 mm stretch netting, and two 59 cm, toothed Gulf rock drags (25 cm high), one on each end. The rock drag not adjacent to the lined mud drag was also lined with a 38 mm stretch mesh liner. Because they rapidly filled with trash (Jamieson et al., 1981), untoothed (Digby) rock drags were not used in this year's Strait surveys. A combination of rock and mud drags was used since it was observed last year that with randomization of station location, no anticipation of substrate type could occur to allow optimal gear useage. Because of poor performance in 1979, no hood over the drags was used in the 1980 surveys.

Except for the P.E.I. survey in the western Strait, where tow duration was seven minutes, tow distance was maintained at

about 800 m by use of the Internav CC2. However, because some variation occurred, scallop height frequencies were weighted in analysis to give a standard tow distance of 800 m. Optimal tow distances in each region on the basis of quantity of trash fished appear to be about 925, 750 and 550 m (1 NM = 1.852 m) in the western, central and eastern regions of the Strait respectively.

For each tow, the following data were recorded: 1) height frequencies in 5 mm intervals for all the live scallops and cluckers fished by each bucket; 2) Loran C bearings at start and end of tow; 3) depth (m); 4) compass bearing (direction) of tow; 5) duration of tow (minutes); 6) ground speed as measured with the CC2; 7) substrate (trash) type; 8) flowmeter readings at the beginning and end of tow; and 9) number of vertical bucket rings counted that were covered by trash. Scallop age was inferred from height by the von Bertalanffy growth parameters given by Jamieson et al. (1981). Adductor muscle yield (w) relative to shell height (h) was determined using the equation

$$\ln (w) = -10.72 + 2.919 \ln (h).$$

This equation was also used in Jamieson et al. (1981) and was calculated from 1978 and 1979 data from the entire Strait. It differs from the equation used in Jamieson (1979).

In drag catch comparisons at various vessel tow speeds, data from the high catch strata in the three regions is combined. Twenty-nine of the 47 stations were from the western Strait, with 15 and 3 stations from the central and eastern Strait respectively (Table 2). The catches per tow of all four buckets were summed.

In regional height frequency and abundance analyses (Table 2), the gear type (mud or rock bucket) having the greatest catch was the one used in prorating individual bucket catches to overall drag catch. Bucket data was prorated to drag catch so as to provide catch values more typical of the commercial fishery. Lined gear catch was used in prorating prerecruit (age <3 yr) values, while unlined gear catch was used in prorating recruit (age >3 yr) values.

Statistical tests for differences between gear performances or catches per stratum or region utilized Tukey's HSD procedure (Steele and Torrie, 1960).

#### B. Log Reports

The same log book format as described by Jamieson et al. (1981) was used during the 1980 fishing season, with one modification. Each unit was subdivided into four equal subareas at the request of fishermen so that better representation of locations of scallop fishing would result. Each subarea was 2 km by 2.8 km, for a total of 5.6  $\text{km}^2$ .

Since daily log completion is not yet required by regulation, fishermen are still completing logs on a voluntary basis. In an effort to provide positive feedback, a summary of each individual's fishing performance (Table 3) as derived from log data was sent out to each fisherman last spring. Performance was presented as catch per unit effort per area fished so that no total catch or effort would be present to cause potential problems with either Revenue Canada or the Unemployment Insurance Commission.

Gear size surveys were conducted at our request by regional fisheries officers in 1979 and by port samplers in 1980. Number of licensed and active fishermen was estimated from scallop fishing licenses, by log returns and by conversations with regional fisheries officers.

#### RESULTS AND DISCUSSION

#### A. Height-Weight Relationships

The seasonal change in scallop meat and gonad weight for a standard scallop shell size (90 mm) has followed a basically similar pattern over the past three years (Fig. 6). Meat weight reached a minimum in August, but rapidly increases in early fall. Gonad weight was minimal in October, as spawning typically commenced by September. 1978 was a year of two spawnings (Jamieson, 1979); a major spawning occurred in July, followed by a second spawning in September.

B. Gear Performance

1) Gear type

Jamieson et al. (1981) demonstrated the unsuitability of untoothed, Digby rock drags for Northumberland Strait scallop stock assessment, and the propensity for lined gear to fish more prerecruits, but fewer recruits, than unlined gear, regardless of drag type. In the 1980 field season, the performance of mud (chain sweep) drags was compared against that of toothed, Gulf rock drags (Table 4).

In the central and eastern regions of the Strait (all strata catches combined), mud drags landed about an equal number of prerecruits but fewer recruits than did rock drags (P>.05). In the western Strait, mud drags landed significantly fewer (P<.05) recruits than did rock drags.

For those stations where scallops were caught, rock drags fished more recruited scallops than did mud drags in 62, 59 and 31% of the stations in the western, central and eastern regions respectively. The better performance of mud drags in the eastern region may not be wide-spread, as only a restricted area was surveyed.

#### 2) Fishing speed

The use of precise navigational equipment has allowed determination of the average speed per tow in which the gear was hauled over the bottom. Because of tidal currents, this speed frequently differs from that of the vessel moving through the water column.

Owing to the inverse correlation between scallop size and swimming ability (Caddy, 1968), prerecruit and recruit data have been separated. Over towing speeds ranging from 53-313 cm/sec, recruit capture rate tended to decrease with increasing tow speed, while prerecruit capture rate had a modal value at about 200 cm/sec (Table 5).

#### C. Resource Surveys

#### 1) Population age structure

Total relative prerecruit and recruit abundance by strata and region (maximum catch from either mud or rock drags) is given in Table 2. Only the catch from lined and unlined rock drags were used in subsequent estimations of relative prerecruit and recruit abundance. Since lined gear retains more prerecruits and underestimates recruits, a combination of the catches of both gear categories was used in determining regional population age frequencies (Table 6). As in 1979 (Jamieson et al., 1981), scallop catch, and hence density, was greatest in order in the high, medium and low catch strata respectively. Highest average density of recruited scallops was in the central region. However, the highest yielding areas of the eastern Strait could not be sampled and so the value from this region may not be representative. In 1979, the eastern Strait had the highest average density of recruited scallops (Jamieson et al., 1981).

The two surveys in the western Strait in May were initially planned to complement each other and thus each survey did not cover the whole fishing zone (Fig. 2). Since the actual distances towed in the P.E.I. charter are unknown, direct comparison (Table 7) of the observations of the two charters is difficult. However, in general, they confirm the relative absence of 4-7 year old scallops compared to scallops >8 years old.

#### 2) Prerecruit abundance

In contrast to the 1979 survey (Jamieson et al., 1981), relatively large numbers of age 1 scallops (14-20 mm in height) were collected over a large area in the western Strait in 1980 (Fig. 7). Sixteen of the 135 stations surveyed (12%) had catches containing more than ten one-year-old scallops, but since a few stations had exceptional quantities of these scallops (Table 8), the variance of average abundance is large. Because of the low selectivity (<1%) of 1-2 year scallops (Jamieson and Lundy, 1979; Dickie, 1955), the actual abundance of the 1979 year class in the western region appears significant. No similar abundance of prerecruits was found in either the central or eastern regions.

#### D. Commercial Fishery

1) Gear

Regulations specify a maximum length of fishing vessel in the Northumberland Strait of <15.24 m (50 feet), but because of different overall lengths and riggings, a wide variety of bucket sizes and types are used in commercial scallop gear (Table 9). Regardless of whether the gear used is rock or mud (sweep chain) drags, the greater the number of buckets, the smaller was individual bucket size. Although one fisherman fished a total gear width >6 m in 1979, average total gear width for rock drags was 3.6 and 3.5 m in 1979 and 1980 respectively. For mud drags, average width was 3.5 m for both years.

#### 2) Number of fishermen

Although many individuals have scallop licenses, not all licenses are active in a given year (Jamieson, 1979). The number of licensed fishermen increased in the eastern Strait, but remained about constant in the other two regions during 1979-1980 (Table 10).

Number of active fishermen  $(N_A)$  is difficult to accurately estimate, since all fishermen do not complete logs and the statistical system utilizing sales slips does not provide the number completing sales slips. As a result,  $N_A$  was estimated in each statistical district by the following equation:

	NA	/	$C_{\rm T} = N_{\rm L} / C_{\rm L}$
therefore,	NA	=	$C_{T} \cdot N_{L} / C_{L}$
where -	NL CT CL		number of fishermen completing logs total annual catch (sales slips) total annual catch (log).

This assumes that total annual catch determined from log data never exceeds that determined from sales slip data, and that average catches for those fishermen that do and do not complete logs are similar. This method gives 369 and 261 active fishermen in 1979 and 1980 respectively. The field survey conducted to measure gear widths suggests that the minimum number of active fishermen was 321 and 206 in each year.

3) Catch and Effort

(a) Sales slip statistics

Landing statistics by month, province and region (Tables 11-13) indicate that landings are reduced in 1980 compared to 1979. Although the fishery started well, catches quickly declined as the season progressed. Largest Northumberland Strait scallop landings are historically made in the spring and early summer, as fall fishing is often impeded by bad weather.

#### (b) Log record statistics

A decrease occurred in the log completion rate (Table 14) in 1980. A requirement for log completion is not yet in regulation and hence when fishermen stop completing logs, there is no method to ensure compliance. Nova Scotia fishermen were most reliable in completing logs. The worst log completion rate was in the central region.

Average CPUE values in 1980 (Table 15) were 1.72, 1.54 and 1.77 kg per hour for each metre of drag width fished in the ten most productive areas of the western, central and eastern regions of the Strait respectively (Table 16). These compared to 1.23, 1.23 and 1.64 kg/hr-m respectively in 1979. Average provincial CPUE values (Table 17) by region decreased over the past year in the western region and increased in the central region. Provincial CPUE in the eastern region remained about the same. It should be noted that since two men characteristically fish scallops on each Northumberland Strait vessel, CPUE values should be halved to give effort per man, the unit of effort used in other scallop fisheries (Jamieson and Chandler, 1980).

Although overall CPUE and scallop price (Table 18) increased in 1980, actual landings appear to have decreased substantially. A monthly comparison of CPUE values (Table 19) indicates some seasoal decline in CPUE occurs, but whether or not this was a main factor to explain the decline in landings is not clear. The 1980 pattern of distribution of fishing locations in Northumberland Strait (Figs. 8-9), presented as percentages of total regional catch, show some annual differences in locations of high yield when compared to 1979 data (Jamieson et al., 1981). Scallop concentrations which allow profitable fishing are often restricted in size, and it is thus not unusual for them to be fished out in a single season.

4) Scallop Height and Age Frequencies in Commercial Fishing

Monthly comparison of scallop age frequency fished (Fig. 10) versus scallop age frequency landed (Fig. 11) indicates that considerable culling occurs at sea. In 1980, port sampling effort was directed towards sampling the catches of a number of vessels on landing, with fishermen being asked to bring in a random sample of their day's catch (40 shells). Occasional sampling at sea was conducted by the port sampler to monitor sample bias, which was found to be minimal. In contrast to the offshore and Bay of Fundy scallop fisheries, individual weighing of meats from a subsample of the catch is logistically difficult in this fishery. The disadvantage of sending a sampler to collect data at sea is that fishermen often make repeat tows over the same ground all day, and once the height frequency of the scallops in that bed has been determined, the sampler's time becomes inefficiently utilized.

Commercial shell height and meat weight frequencies can be transformed to meat count per half kilogram frequencies. Commercial meat counts at landing are often determined by blending meats of various sizes. Assuming all size scallops are equally available and optimally exploited, an estimate of the average meat count landed is indicated by the meat count at 50% cumulative frequency (Fig. 12), weighted by meat yield. Average meat counts per half kilogram of 23, 35, and 28 thus characterize the scallop fisheries in the western, central and eastern Strait respectively.

On a regional basis, pronounced modal ages of exploitation exist. In the western region, mostly 11+ yr-old scallops are fished, whereas in the other two regions, modal ages are typically between 5 and 8 yrs of age.

#### DISCUSSION AND CONCLUSIONS

The quality of data for stock assessment derived from a resource survey involving sample tows depends on two main factors: 1) knowing the area of sea bottom swept by the gear, and 2) the selectivity of the gear. In recent, unpublished

studies of gear selectivity with toothed Gulf drags and mud (sweep chain) drags in the Northumberland Strait, no conclusive results could be attained because of very low scallop abundance in the study area (about 1 scallop/10 m<sup>2</sup>). Although scallop density is expected to be somewhat greater on other commercial scallop grounds, sufficiently high scallop densities (preferably  $>1/m^2$ ) could not be located in areas accessible to divers. However, Caddy (1968) located ground with a scallop density of  $5-6/m^2$  in 1967, and so high scallop densities can occasionally occur. Until such ground is located, selectivity of unlined gear can only be estimated by comparison with lined gear performance (as in Jamieson and Lundy [1979]), and lined gear selectivity of prerecruits cannot be determined.

Use of accurate navigational equipment to estimate tow length has allowed a significant improvement in data quality, since each tow's catch is now prorated to that expected with an 800 m tow on the ocean bottom. When tow duration is standardized for time only, variables such as tidal current and wind drift, are not considered, and actual distance towed can vary considerably. This equipment also allows the accurate measurement of gear speed on the sea bottom. Caddy (1968) investigated the reactions of scallops to drags, and noted that at low vessel speeds (<2 kn), some scallops disturbed by the drag remained in front of the drag at the end of the flight response. At greater vessel speeds, the drag frequently passed beneath swimming scallops, which escaped by subsequently dropping behind the drag. At the highest speeds, some scallops were caught by the drag as they rose from the bottom, and fewer individuals escaped to the side of the drag. Actual drag speed on the sea bottom was not reported by Caddy (1968), and so his speed values are only meaningful in a relative sense. They do stress, however, the potential importance of this variable in the interpretation of resource survey results. It appears that the optimum speeds for capturing prerecruits and recruits may differ, but additional study is required to define them. Variation between stations in both scallop abundance and relative scallop size frequencies may have introduced bias in the present study.

Confirmation of the scarcity of 2-6 year old scallops in the western region by the two May resource surveys resulted in a meeting of the Northumberland Strait Scallop Advisory Committee in late May, 1980. A scallop closure zone (Fig. 13) in the western Strait was recommended for an indefinite period of time at this meeting. This zone was created to: 1) allow establishment of a "preserve" where sufficient adult stock could exist to allow maximum spawning success and hopefully improve future recruitment (the apparent lack of significant recruitment in recent years, and the fact that this population is on the fringe of the species' geographical distribution, created concern that the population was only marginally selfsustaining and was particularly subject to stress); 2) prevent indirect fishing mortality from decimating the newly located concentrations of prerecruits (Fig. 7).

With establishment of this closure zone on June 24, 1980, fishermen were allowed to exploit other populations in the region so long as all regulations (Table 1) were adhered to. The existence of this zone should offer sufficient protection of the western Strait stock to facilitate spawning success, and so no new conservation measures are proposed for the coming season.

In the central region and eastern regions, scallop stocks appear stable with each age class reasonably well represented. Landings are likely to increase significantly only as a result of above-average recruitment, which does not appear imminent. Management should thus continue towards maximization of yield per recruit.

This year's landings are reduced in comparison to 1979's landings, while average CPUE and price (Statistics Branch, Fisheries and Oceans Canada, Halifax, N.S.) are both higher. This suggests that in a multispecies fishery such as exists in the Northumberland Strait, magnitude of landings may reflect relative fishery performance more than stock status. Multispecies stock management may thus be necessary, as only in this way may the overall dollar value of competing fisheries be maximized and optimum yields for all the fisheries be attained.

#### SUMMARY

- Resource surveys confirm relatively low recruitment of scallops in recent years in the western Strait. Since this population is on the fringe of the species' distribution and assuming that the stock is self-sustaining, conservative exploitation is advisable.
- 2. The 1979 year class in the western Strait appears to be above average in abundance, with little evidence of this year class in the other two regions.
- 3. Scallop landings decreased in 1980, although CPUE and price increased. Possible explanations are more profitable alternate fisheries and/or bad weather.
- The frequency of log record completion is decreasing, since regulations requiring their completion do not yet exist.

5. Average CPUE was 1.77, 1.54 and 1.72 kg of meat per hour for each metre of drag width fished, for the ten most productive unit areas in the eastern, central and western Strait, respectively.

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Table 1. Regulations (\*) and policy applied to the Northumberland Strait scallop fishery in 1980.

Lobster District 8	Lobster District 7bl
*Season: April 28 - July 12 October 11 - December 31	*April 7 - July 15 September 15 - December 31
Meat count: $45/1b (50/\frac{1}{2} \text{ kg})$	48/lb (53/½ kg)
Log books: required	required
*License: freeze on all new entrants	*new entrants permitted if they have fished 30 weeks over the past 2 years for either lobster or scallop, and are considered a bona fide commercial fisherman
*Closed area: shaded area in Fig. ll is closed indefinitely to scalloping as of June 24, 1980	

Table 2. Strata designation and average scallop catch per tow by age grouping
in each of the three catch strata in each region of the Northumberland Strait.
4+ year-old scallop abundance was estimated from the catch of an unlined drag,
while 1-3 year-old scallop abundance was estimated from the catch of a lined
drag.

Stratum	%* (Stratum range)	N* (Total no. of areas)	n* (areas sampled)	n (sta- tions)	<u>1</u> -3	Age (yr 4-7	·) 8+	Total 4+ yr
Western†								
High Medium Low	5+ 2-4.99 0-1.99	5 11 27	5 5 9	29 23 13	29.9 33.8 5.1	4.6 2.4 1.6	12.9 8.7 13.6	17.5 11.1 15.2
Central								
High Medium Low	4+ 1-3.99 0-0.99	3 13 22	2 11 12	15 24 21	5.4 9.6 4.3	30.4 31.2 20.7	9.9 11.6 12.2	40.3 42.8 32.9
Eastern								
High Medium Low	5+ 1-4.99 0-0.99	4 15 13	2 2 7	3 5 11	0.9 1.7 0.8	5.6 12.0 5.1	11.7 13.7 5.1	17.3 25.7 10.2

\*includes subareas †data only from the New Brunswick charter

Table 3. The format in which each fisherman's log data is summarized and returned to him at the end of each fishing season.

#### FISHERIES & OCEANS CANADA -- RESOURCE BRANCH

SCALLOP FISHERMAN REPORT FOR JANUARY - DECEMBER 1979

PROVINCE NEW BRUNSWICK			FISHERMAN'S NAME	JOHN DOE
STATISTICAL DISTRICT 80 -		CAP -PELÉ	TO TIDNISH	
	AREAS FISHED	NO. OF VISITS TO THE AREA	CATCH AS A % OF TOTAL CATCH	CATCH PER UNIT EFFORT
	149 157 158 166	4 12 7 3	16.10 44.25 28.82 10.83	0.62 1.14 1.05 0.98
AVERAGE	4	26	100.00	0.97

Catch is defined as the weight in kilograms (one kilogram = 2.205 pounds) of scallop meat landed.

Effort is defined in metre-hours, where the width of your gear (10 rock drags, each 18 inches wide; 0 sweep chain drags each 0 feet wide) in metres is multiplied by the number of hours your gear was on the sea bottom (tow duration times number of tows).

Therefore, the average value of catch per unit effort means that for every hour each metre of drag width was fished, 0.97 kilograms of meat was landed.

We hope that this information will prove useful to you in the next fishing season. The value of this data to us both depends on your co-operation in the accurate completion of scallop log records.

Table 4. Average catch at age per 4-gang drag per tow, all strata stations combined, for lined (A) and unlined (B) rock and mud buckets in the three regions of Northumberland Strait. \* = data only from the May, New Brunswick charter.

Region and	No. of					A	.ge (y	r)				
Stratum	stations	1	2	3	4	5	6	7	8	9	10	11+
A. Lined Gear												
West*												
rock mud	64 64	3.9 3.8	0.1	0.2 0.3	0.1 0.2	0.2 0.1	0.1 0	0.1 0.1	0.2 0.1	0.2 0	0.1 0	0.9 0.4
Central												
rock mud	60 60	0.1 0.2	0.5 0.3	0.6 0.5	0.8 0.5	0.9 0.6	0.6 0.5	0.4 0.3	0.5 0.3	0.3 0.3	0.1 0.2	0.2 0.2
East												
rock mud	19 19	0.1 0	0 0.1	0.1 0.1	0.1 0	0.2 0.3	0.3 0.3	0.2 0.5	0.3 0.4	0.3 0.3	0.1 0.1	0.4 0.6
B. Unlined Gea	r											
West*												
rock mud	60 64	0.1 0.8	0 0	0 0	0.1 0.1	0.3 0.2	0.2 0.1	0.2 0.1	0.4 0.3	0.4 0.3	0.3 0.1	1.6 0.8
Central												
rock mud	60 60	0.1 0.1	0.5 0.1	1.0 0.2	1.6 0.5	2.1 1.1	1.4 1.6	1.1 1.4	1.0 1.1	0.5 0.5	0.2 0.2	0.2 0.6
East												
rock mud	19 19	0 0	0 0	0 0	0.1 0.3	0.3 0.6	0.6 0.5	0.7 0.2	0.7 0.1	0.6 0.1	0.3 0.1	0.8 0.6

			Average Scallop Catch								
Vesse	l Speed	PI	cerecru	its		Recru	cruits				
(25 cm/sec intervals)	(0.5 kn intervals)	n	Avg	SE	n	Avg	SE				
62.5	1.2	1	9	0	1	54	0				
87.5	1.7	2	4	2.5	3	19	13.0				
112.5	2.2	6	4	1.7	8	23	5.1				
137.5	2.7	4	2	1.3	5	11	5.7				
162.5	3.2	8	· 9	4.8	6	7	1.6				
187.5	3.7	6	19	9.1	10	15	5.5				
212.5	4.1	1	4	0	5	12	4.0				
237.5	4.6	00723	80733	4000	1	8	0				
262.5	5.1	2	7	5.5	2	23	8.5				
287.5	5.6	spinia	-	belle			40000				
312.5	6.1	4000	809	MNG	1	4	0				

Table 5. The relation between gear velocity on the sea bottom and scallop catches in the high CPUE strata in Northumberland Strait in 1980. 1 kn = 51.4 cm/sec.

Region &	No. of	Age (yr)										
Stratum	stations	1	2	3	4	5	6	7	8	9	10	11+
West*								<u></u>				
High Medium Low	29 22 13	15.6 29.6 2.1	0.1 0.5 0.3	0.6 0.7 0.3	1.1 0.6 0.1	1.0 1.2 0.8	0.9 0.5 0.6	2.0 0.1 0.1	3.3 0.4 1.0	3.0 1.1 1.4	1.5 0.6 0.7	4.7 6.2 8.8
Central												
High Medium Low	15 24 21	0.4 1.2 0.1	1.4 2.9 1.2	3.4 2.1 2.5	7.2 8.0 3.8	10.4 9.7 5.5	7.2 6.2 3.1	4.4 4.5 3.9	3.2 3.9 4.8	2.0 2.3 2.5	1.0 1.0 1.0	0.3 0.6 1.7
East												
High Medium Low	3 5 11	0 0.8 0	0 0 0	0 0 0.9	0 0.8 0.2	1.1 1.9 0.2	2.7 3.7 1.2	1.5 5.2 1.4	4.1 3.1 1.2	4.2 2.2 1.2	2.2 1.1 0.6	1.3 7.2 1.6

Table 6. Average catch per tow (800 m) of a 4-gang rock drag in each of the three strata in each region of Northumberland Strait. Ages 1-3 (prerecruits): from lined gear; ages 4+ (recruits): unlined gear. \*: data only from the May, New Brunswick charter.

		n	an for the second se	Age (vears)	une na antikoleka kala managga apolo sa kala kala kala kala kala kala kala k
			1-3.	4-7	8+
High	Catch Strata:			nya na katala na kat	n y nanonikan karangan karanga
Α.	lined rock	41	26.3	1.8	7.3
	unlined rock	41	0.2	2.0	10.7
	lined sweep	41	31.9	1.6	5.0
	unlined sweep	41	0.2	1.8	12.8
В.	lined rock	29	5.0	0.7	1.3
	unlined rock	29	0.5	1.5	3.8
	lined sweep	29	10.0	0.3	0.5
	unlined sweep	29	2.3	0.9	2.4
Medi	um Catch Strata:				
Α.	lined rock	24	1.7	4.4	7.1
	unlined rock	24	0.4	5.5	10.1
	lined sweep	24	4.0	5.2	4.4
	unlined sweep	24	0.2	6.6	10.9
Β.	lined rock	22	9.3	0.6	2.3
	unlined rock	22	0.1	0.7	2.5
	lined sweep	22	5.7	0.3	0.9
	unlined sweep	22	1.1	0.5	1.4
Low (	Catch Strata:				
Α.	lined rock	2	0.0	0.0	2.6
	unlined rock	2	0.0	3.3	6.3
	lined sweep	2	0.0	0.0	2.9
	unlined sweep	2	0.0	1.0	1.9
В.	lined rock	13	0.8	0.4	1.4
	unlined rock	13	0.0	0.5	3.7
	lined sweep	13	0.8	0.8	0.6
	unlined sweep	13	0.0	0.3	2.4

Table 7. Western Northumberland Strait scallop catch summaries by strata and bucket type, April 1980. A. Ten-minute tow duration, actual distance unknown. B. 800 m tow distance.

No Scalle	ops	Stn. No.	Area No.	Latitude	Longitude
West					
N.B.	Charter				
	183	8	25	46°47'54"	64°35'58"
	30	9	25	46 49 14	64 35 19
	14	13	38	46 48 16	64 31 09
	45	14	39	46 46 30	64 31 27
	40	30	26	46 46 21	64 34 56
	31	35	39	46 47 16	64 30 28
	53	37	39	46 47 18	64 30 35
	87	38	39	46 46 28	64 31 07
	30	39	39	46 46 07	64 31 32
	26	66	55	46 48 48	64 29 55
P.E.I	. Charte	er			
	12	12	39	_	LDE
	95	13	39	_	
	43	14	39		
2	185	16	26	-	
	10	50	74		
	28	68	53	0000	

Table 8. Numbers of one-year-old scallops fished by two lined buckets in 1980 at stations where the number of such prerecruits exceeded ten per tow.

		No. Buckets	NO. Fishermen	MEAN bucket width (m)	Std. Dev. (m)	Total gear width (m)
Rock Drags	1979	2 3 4 5 6 7 8 9 10 11 12 13 14	$2 \\ 27 \\ 106 \\ 30 \\ 47 \\ 12 \\ 25 \\ 25 \\ 25 \\ 11 \\ 0 \\ 17 \\ 0 \\ 1 \\ 303$	$\begin{array}{c} 0.81 \\ 0.79 \\ 0.79 \\ 0.71 \\ 0.50 \\ 0.51 \\ 0.59 \\ 0.53 \\ 0.51 \\ - \\ 0.47 \\ - \\ 0.46 \end{array}$	0 0.08 0.06 0.13 0.09 0.08 0.07 0.08 0.08 0.08 0.04	1.622.373.163.553.003.574.724.775.10-5.64-6.44
Mud Drags		1 2	40 <u>27</u> 67	2.56 2.43	0.48 0.06	2.56 4.86
Rock Drags	1980	3 4 5 6 7 8 9 10 11 12	$9\\86\\27\\41\\15\\29\\3\\5\\0\\-6\\221$	0.80 0.77 0.71 0.53 0.48 0.63 0.48 0.46 	0.09 0.07 0.13 0.12 0.09 0.12 0.04 0.01	2.40 3.08 3.55 3.18 3.36 5.04 4.32 4.60 
Mud Drags		1 2 4	$ \begin{array}{r} 16\\ 9\\ \underline{1}\\ 26 \end{array} $	2.84 2.33 1.22	0.60 0.22 0	2.84 4.66 4.88

Table 9. Individual bucket width and numbers fished in drag gangs by scallop fishermen in the Northumberland Strait in 1979 and 1980.

			1979		1980		
Province	District	No. Licenses	No. Active	No. Sub- mitting Logs	No. Licenses	No. Active	No. Sub- mitting Logs
Nova Scotia	2 3 10 11 12 13 45 46	2 6 2 53 12 25 0 0	- 34 1 8 - 0	0 0 28 1 8 0 4	3 5 3 56 14 28 0 0	- 32 1 7 0	- 20 1 3 - 2
New Brunswick	75 76 77 78 80A	12 30 19 21 66	12 30 12 20 55	8 23 1 3 41	14 29 17 20 66	11 34 0 - 42	5 8 5 - 19
Prince Edward Is	82A 83 85 86 87 88	37 14 6 27 148 45	35 14 3 27 79 2	13 12 3 18 30 1	36 13 6 34 154 61	22 0 19 88 -	11 4 16 18 -
TOFAL		525	332	194	559	256	112

Table 10. Estimated numbers of licensed and active fishermen, and the number of fishermen who completed at least one log record, in 1979 and 1980. Source: Field Services Branch, Halifax, N.S.

		Landings ()	ca)
	N.B.	N.S.	P.E.I.
<u>1979+</u> :			
March April May June July August September October November December	133,425 345,052 225,177 7,535 - 565 4,487 4,894	7,184 1,585 5,856 40,221 	365 157,734 152,465 161,042 248,147 11,614 33,288 142,027 45,586
Total Round Weight (ko Meat Weight (t)	a) 721,135 87	129,496 16	952,268 115
<u>1980</u> :			
April May June July August September October November December	51,544 350,628 140,163 34,849 5,497 1,340 1,709	3,249 437 5,481 29,579 11,828 48,017 51,197	122,844 209,479 103,550 163,762 75 29,585 134,271 41,027 1,653
Total Round Weight (kg Meat Weight (t)	585,730 71	149,788 18	806,246 97

Table 11. Monthly scallop landings in Northumberland Strait in 1979 and 1980 (values are suggested to be underestimates of actual landings).

+3% of total landings may be gonad

Province	Statis- tical District	Løbster District	Representative Ports	1979+ annual landíng (round kg)	1980 annual landing (round kg)
Nova Scotia	11	7bl	Caribou, Toney R., Cape John	108,507	141,960
	12	7bl	Lismore	4,133	4360
	13	7bl	Bayfield, Cribben's Pt.	6,356	5,370
	45	8	Pugwash	5,052	1,648
	46	7bl	Wallace	5,248	780
New Brunswick	75	8	Cape St. Louis, Kouchibouquac	24,704	14,683
	76	8	Richibucto, Richibucto Cape	171,335	179,374
	77	8	Buctouche	89,739	4,799
	78	8	Shediac, Cap-Pelé	83,659	51,115
	80A	8	Murry Corner, Cape Tormentine	351,698	335,749
Prince Edward Is	• 82A	8	Howard Cove, Miminegash	216,021	195,357
	83	8	Borden	75 <b>,</b> 853	44,820
	85	7bl	Victoria	1,277	2,684
	86	7bl	Wood Is., Charlottetown	203,529	209,740
	87	7bl	Beach Pt., Gaspereau	445,587	339,104
	88	7bl	Annandale	10,001	14,541

Table 12. Regional scallop landings in Northumberland Strait in 1979 and 1980.

+3% total landings are roe

	19	79+	198	0
	eastern	western	eastern	western
Month	7bl	8	761	8
January				
February				
March	365			
April	128,531	169,812	108,997	68,640
May	38,899	460,203	61 <b>,</b> 702	498,842
June	44,244	347,831	47,961	201,203
July	275,775	20,128	181 <b>,</b> 071	47,109
August	11,614	-	****	5,572
September	43,916	565	40,950	1,803
October	169 <b>,</b> 920	8,617	180 <b>,99</b> 5	3,002
November	71,374	10,905	90,850	1,374
December			1,653	
Total Round				
Weight (kg)	784,638	1,018,061	714,179	827,545
Meat Weight (t)	95	123	86	100

Table 13. Monthly Northumberland Strait scallop landings in Lobster Districts 7bl and 8 in 1979 and 1980.

+3% total landings are gonad

Table	24.	Prel	imina	ary sal	les s	lip	and	log	scall	op	catch	(kg)
stati	.stics	for	each	provir	nce i	n ea	ich i	regio	n of	the	North	umber-
land	Strait	in	1980	(1979	incl	uđeđ	l foi	c com	paris	on)	•	

		<u>Statistic</u> Sales Slip Catch (kg)	Region Report Log Record Catch (kg)	1980 % (log/SS)	1979 % (log/SS)
Western	N.B. P.E.I.	23,959 23,537	10,403 11,609	43 49	45 37
Central	N.B. N.S. P.E.I.	46,610 199 5,723	8,016 2,260	17 0 39	63 0 73
Eastern	N.S. P.E.I.	17,845 67,878	11,683 22,832	65 <u>34</u>	89 45
Total (}	kg) t	185,751 186	66,803 67	36	53

Area Square (	Landings ŧ (kg)	CPUE (kg/hr-m)	Area Square #	Landings (kg)	CPUE (kg/hr-m)
0000	6242.8		0744	115.6	0.8
0160	276.6	1.2	0750	334.7	
0220	106.1		0770	490.3	2.3
0230	207.7	2.0	0780	1018.7	2.5
0240	433.6	1.6	0890	178.7	1.2
0250	406.4	0.7	0903	204.5	1.0
0260	702.1	0.6	0904	325.6	1.0
0263	165.1	2.0	0910	1161.2	1.2
0280	168.2	0.7	0920	162.8	1.0
0360	126.1	2.9	1050	143.3	1.1
0370	410.5	1.5	1060	114.7	1.8
0380	608.7	0.7	1070	518.4	_
0390	425.4	-	1484	104.7	1.8
0394	121.1		1500	106.5	_
0400	910.3	0.6	1560	641.8	1.7
0410	179.6	2.4	1570	1045.9	1.2
0420	235.4	0.8	1572	270.7	2.2
0530	589.2	1.3	1580	212.7	1.9
0540	551.1	1.3	1650	501.6	1.7
0550	954.3	1.1	1653	113.3	1.1
0560	239.4	0.7	1660	1015.6	1.6
0562	267.6	0.8	1661	728.4	1.4
0564	222.7	0.6	1664	116.5	1.2
0570	180.5		1740	413.6	0.9
0590	2170.4	-	1741	120.2	929
0600	1210.1	3.1	1750	1025.5	1.1
0610	178.7	2.5	1760	104.3	1.1
0724	177.8	0.9	2320	314.7	1.9
0730	716.2	1.5	2390	119.7	0.9
0731	298.4	-	2460	153.3	1.1
0734	117.4	1.0	2483	137.4	1.3
0740	1076.3	2.6	2490	124.7	1.8

Table 15. Landings (kg) and average CPUE (kg/h-m) for each designated log area (see Fig. 4) in 1980 in which a catch greater than 100 kg was reported to have been fished.

Table 15 (Continued)

Area Square	#	Landings (kg)	CPUE (kg/hr-m)	Ar Squa	ea re #	Landings (kg)	CPUE (kg/hr-m)
2510		1517.7	1.4	267	'3	437.7	4.3
2520		539.3	1.8	268	0	1796.6	1.9
2522		241.3	2.7	268	3	201.3	1.8
2550		4689.7	1.2	269	0	620.5	1.6
2560		1862.0	1.3	270	0	201.8	1.9
2561		1214.7	1.5	273	0	295.7	1.7
2563		128.3	1.5	274	0	3338.0	1.5
2570		680.8	1.8	274	1	134.7	2.8
2600		215.9	1.3	274	2	600.5	-
2610		288.9	1.8	274	3	337.0	3.4
2620		1098.6	1.7	274	4	156.4	-
2621		187.3	1.6	275	0	1415.6	2.2
2623		487.1	1.5	276	3	287.5	3.8
2624		151.5	2.2	276	4	279.8	2.3
2630		1197.4	1.8	277	0	962.9	
2631		529.3	2.0	286	0	100.6	0.5
2632		480.8	1.9	287	0	468.5	1.8
2633		146.5	1.8	288	0	114.7	2.8
2634		169.6	1.9	311	0	290.3	3.0
2640		533.8	1.7	315	0	111.5	1.6
2644		220.4	1.8	323	0	166.0	1.5
2660		201.3	2.0	324	0	210.0	1.1
2670		3045.4	1.9	339	0	298.4	1.3
				415	0	154.2	1.7

Table 16. Percent of the total catch fished and catch per unit	
effort (kg meat per hour for each metre of drag fished) from the ten	
most productive unit areas (Fig. 7) in each region of the	
Northumberland Strait as reported by log records. * = weighted	
average.	

		West			Centra	1	East		
	Sq.No.	, <sup>0</sup> 0	CPUE	Sq.No.	do do	CPUE	Sq.No	• <sup>0</sup>	CPUE
Charles and a contract of the second s	59	9.86		166	18.92	1.60	274	13.23	1.77
	74	5.63	2.43	157	13.35	1.46	265	13.12	1.30
	91	5.62	1.27	175	11.87	1.09	267	10.31	2.13
	60	5.44	3.15	156	6.25	1.70	256	8.86	1.40
	73	5.14	1.51	165	5 <b>.9</b> 8	1.63	263	6.86	1.99
	78	4.63	2.59	174	5.51	1.21	262	5.76	1.95
	40	4.14	0.61	77	4.13	2.63	268	5.40	2.25
	55	3.86	1.36	158	3.12	1.19	251	4.59	1.36
	56	3.32	0.78	150	1.59	3.45	275	4.23	2.19
	26	3.06	0.67	167	1.45	1.02	252	2.26	1.98
Total	9	40.84	1.72*	10	72.17	1.54*	10	74.62	1.77*
Total cato from regio (t meat)	:h on	22			10			35	

7<sup>84</sup> . 1

Province	Region	<u>CPUE (kg/1</u> 1980	nr-m) 1979
Prince Edward Island	West	1.09	1.37
	Central	1.28	1.11
	East	1.58	1.68
New Brunswick	West	1.01	1.12
	Central	1.40	1.21
Nova Scotia	East	1.70	1.53

Table 17. Average provincial CPUE values for all regions fished in 1979 and 1980 (1979 for comparison).

	Statist	1979 Statistical District			1980 Statistical District		
Month	76	80	87	76	80	87	
January	i i i i i i i i i i i i i i i i i i i	<u>,,,,,,,</u> ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					
February							
March							
April		6.61	6.99		8.27		
Мау		6.86	7.05	8.64	8.27	8.27	
June	6.83	7.03	7.05	8.27	7.72	8.27	
July	6.83		7.03	8.22	7.98	8.11	
August		6.11	6.83	7.98	7.72	8.22	
September	6.83		6.92			8.27	
October		9.37	7.14	7.98	7.96	8.82	
November		9.37	8.11	8.71		8.82	
December	6.83		8.16			9.41	

Table 18. Average price (dollars)/kg of scallops sold in the Northumberland Strait in 1979 and 1980.

Month	<u>West</u> 1979	ern 1980	<u>Cent</u> 1979	ral 1980	Easte 1979	ern 1980
April	3.41	1.00	1.18	1.60	2.09	1.94
Мау	1.30	1.33	1.26	1.32	2.02	1.62
June	1.13	1.46	1.35	1.02	1.51	1.38
July	0.96	0.80	0.92		1.67	1.64
August						
September		0.60	0.51		1.45	1.21
October			0.73		1.40	1.62
November			0.93		1.34	1.90
December					1.49	2.00

Table 19. Average monthly CPUE values (kg/hr-m) weighted by catch for each of the three Northumberland Strait scallop regions in 1979 and 1980.





Fig. 2. Resource survey stations locations in the western Strait. Numbers are area designations. ©: New Brunswick Charter; o: P.E.I. charter.  $\overset{\boldsymbol{\omega}}{_{\boldsymbol{\omega}}}$ 



Fig. 3. Resource survey station locations in the central Strait. Numbers are area designations.



Fig. 4. Resource survey station locations in the eastern Strait. Numbers are area designations.

ω σ



2&3 : Gulf Mud Drags (chain sweep) with Pressure Plate





Fig. 6. Seasonal and annual fluctuations in (A) meat and (B) gonad wet weights for a 90 mm scallop in the eastern region of Northumberland Strait.



Fig. 7. Station locations in the western Strait where more than ten scallops less than age three were fished.
Shaded area delimits the scallop fishing closure zone established on June 24, 1980.
New Brunswick charter; o: P.E.I. charter.



Fig. 8. The geographical distribution and relative magnitude (% of total regional catch) of scallop catches in each area in both the western and central regions of the Northumberland Strait.



Fig. 9. The geographical distribution and relative magnitude (% of total regional catch) of scallop catches in each area in the eastern region of Northumberland Strait.



Fig. 10. The monthly age frequencies of scallops as landed on vessels in commercial fishing in Northumberland Strait. Values = number of tows.



Fig. 11: The monthly age frequencies of scallops as landed at port in commercial fishing in Northumberland Strait. Values = number of scallops.

Fig. 12. Commercial scallop meat weight frequencies at landing, expressed as number of meats per 0.5 kg, for the months of May and June in each region of Northumberland Strait. A,C,E: percent at meat count; B,D,F: accumulative percent at meat count, weighted by meat yield. (An estimate of average regional meat count at landing per month can be obtained from the abscissa at the point of 50% accumulative frequency.)



Fig. 13: The latitudes and longitudes of the scallop closure zone established on June 24, 1980, in the western region of Northumberland Strait.