Medium-Term Value Of Stock Thinning For Oyster Resource Enhancement — Dunk River, P.E.I. (Part 2 of 2)

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Stock thinning of three high-density oyster beds was conducted in the Dunk River estuary in 1977. The impact of this project on oyster density, population structure, standing stock, and on the market-size oyster quality and value was assessed in 1980. The project did not significantly alter the oyster population structure nor the quality breakdown of the market-size oysters on the thinned beds. Oyster density in 1980 was not significantly different from 1977 on two beds; a soft-bottom bed had a significantly lower oyster density in 1980. Oyster unit value showed marginal improvements on all three beds between 1977 and 1980. A stock exploitation strategy is outlined and briefly discussed.

Key words: oyster, management, density, quality, value.

RÉSUMÉ

Lavoie, R.E. and C.F. Bryan. 1981. Medium-term value of stock thinning for oyster resource enhancement - Dunk River, P.E.I. (Part 2 of 2). Can. Tech. Rep. Fish. Aquat. Sci. 1010: v + 13 p.

On a procédé, en 1977, à l'éclairicissage d'huîtrières à peuplements denses dans l'estuaire de la rivière Dunk. L'impact de ce projet sur la densité des huîtres, la structure de la population, la quantité totale d'huîtres dans la population, et sur la qualité et la valeur des huîtres marchandes a été évalué en 1980. L'éclaircissage n'a causé aucun changement significatif ni dans la structure de la population ni dans la qualité des huîtres marchandes. Sur deux des huîtrières éclaircies, la densité des huîtres en 1980 ne différait pas significativement de celle de 1977. Sur une huîtrière éclaircie à fond mou, la densité de 1980 était significativement plus basse que celle de 1977. La valeur unitaire des huîtres s'était légèrement améliorée sur les trois huîtrières éclaircies entre 1977 et 1980. On introduit et discuste brièvement une stratégie d'exploitation.

NOTE - Reference for Part 1 is as follows:

Lavoie, R.E. and C.F. Bryan. 1980. Impact of stock thinning and relocation on oyster quality and value - Dunk River, P.E.I. (Part 1 of 2). Can. MS Rep. Fish. Aquat. Sci. 1587: v + 15 p.

INTRODUCTION

The estuary of the Dunk River, Prince Edward Island, hosts one of the most productive populations of the American oyster (Crassostrea virginica Gmelin) in the province.

In 1975, a joint federal/provincial oyster development project involving the Dunk River oyster beds was initiated. One of the objectives of the project was to improve oyster shell quality on natural beds by thinning the stock in overcrowded areas. This quality improvement technique has been recommended by several authors (Needler, 1941; Medcof, 1961; MacKenzie, 1975).

The short-term impact of stock thinning on oyster quality and value in the Dunk River population has already been described (Lavoie and Bryan, 1980): after one year, the 1975 thinning had not produced a statistically significant increase in the quality of market-size oysters ($\ell > 7.6$ cm). However, a significant increase of the Standard pre-market oysters (6.3 cm $< \ell <$ 7.6 cm) and a significant decrease of the Commercial group were recorded. The 1976 stock thinning produced in one year a statistically significant quality increase of both market-size and pre-market oysters. Both market-size and pre-market oysters left on the natural beds after the stock thinning operations appreciated in value by percentages ranging from 12.9% to 24.5%.

This report investigates whether short-term gains in quality and value have been maintained over the medium-term under the influence of normal exploitation pressure by the fishermen. More precisely, this report describes the 1980 density, structure and standing stock of the oyster populations involved in the 1977 stock thinning operation, and quantifies the changes observed. The report also quantifies and compares the 1977 and 1980 quality breakdowns and standing values of the market-size oysters within the areas involved in the 1977 stock thinning operation.

MATERIAL AND METHODS

The boundaries to the high-density areas of the natural oyster bed were first ascertained by SCUBA divers. Three high-density beds were determined for the 1977 stock thinning and identified as Oyster Point Bed, Hird Point Bed and Channel Bed (Fig. 1). The corners of the beds were marked and sextant bearings recorded for area calculation (Table 1) and future relocation. These beds were surveyed in late July 1977 to

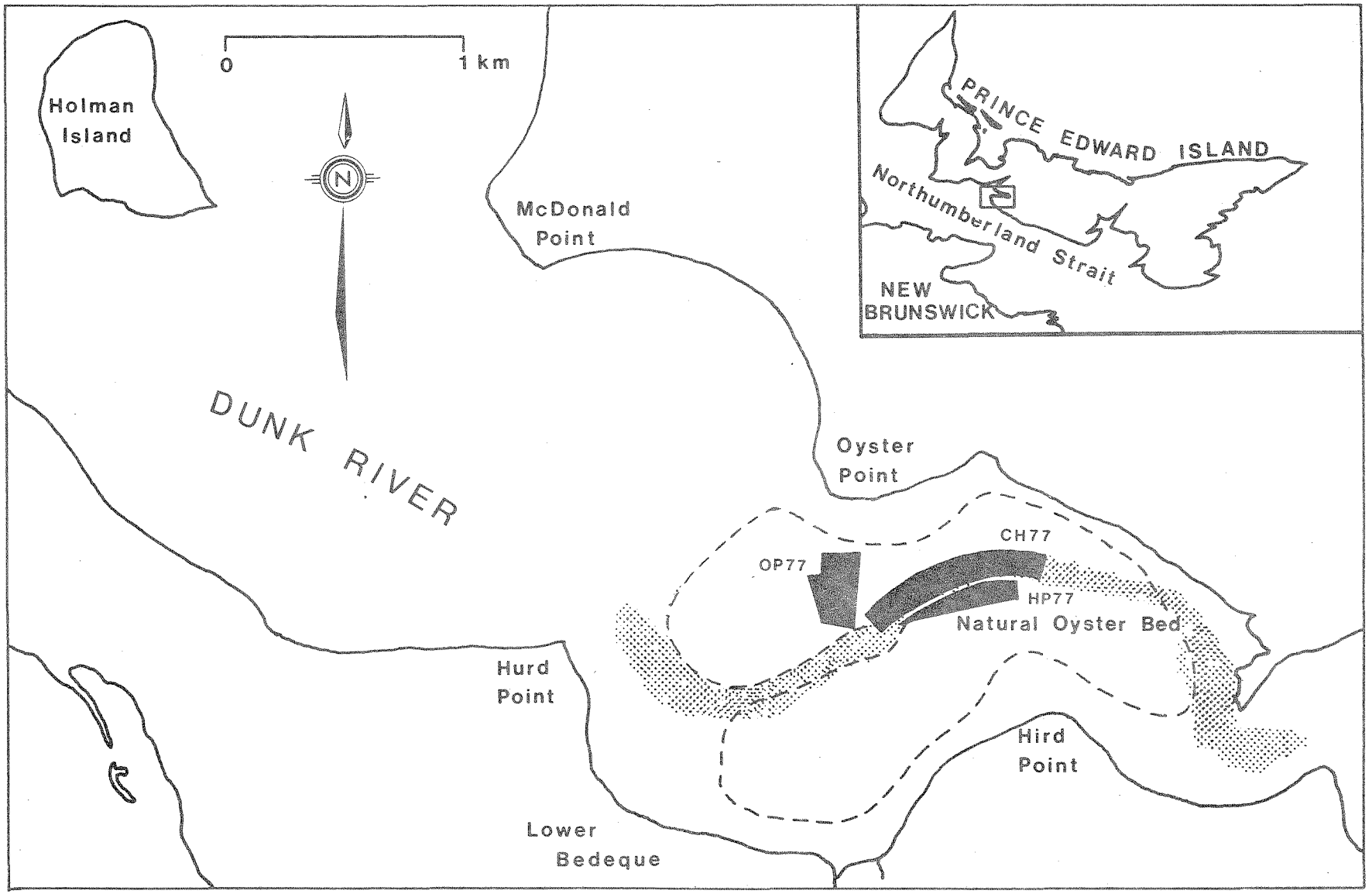

Figure 1. Location of the Oyster Point Bed (OP 77), the Hird Point Bed (HP 77) and of the Channel Bed (CH 77) within the Dunk River estuary.

Table 1. Oyster bed area, number of 1/4 m^2 samples, sampling fraction, confidence limits of the standing stock estimates in 1977 and 1980, and 1977 stock thinning quotas in Metric Tons and as a percentage of estimated standing stocks for the Oyster Point, Hird Point and Channel beds.

	Beds		
	Oyster Point	Hird Point	Channel
Area (ha)	4.7	2.2	5.3
Number of samples			
- 1977	9	4	9
- 1980	16	20	29
Sampling fraction			
- 1977	1:9,895	1:11,000	1:6,839
- 1980	1:11,750	1:4,400	1:1,828
Confidence Limits (% of est.)			
- 1977	20.6	98.6	82.6
- 1980	14.1	20.6	56.9
Stock thinning quota (1977)			
- Metric Tons	98.0	49.0	20.4
- % of standing stock	9.3	5.5	15.4

determine oyster density and standing stock after closure of the spring fishery (May 1 - July 15).

Sampling was done by throwing a 1/4 m^2 grid over the side of the boat and having a diver collect all oysters, shells, and other material present within the grid.

Laboratory treatment of the samples involved sorting of oysters from other shellfish, shells, and bottom material. Length measurements of all oysters were determined along the longest axis of the shell. All live oysters older than one year were measured. Spat of the year were disregarded.

The standing stock of each bed was determined before oyster quotas were calculated. The quotas to be removed (Table 1) were deliberately kept under 20% of the estimated standing stock since it was felt a more severe density reduction might affect reproductive success and result in reduced oyster sets.

The confidence limits of the 1977 standing stock estimates were calculated ($P = 0.95$) according to the method proposed by Downing (1979) before conducting the 1980 sampling. The results prompted us to modify the sampling fraction and the number of samples in 1980 to improve the precision of the standing stock estimates (Table 1).

The 1977 quality breakdown was obtained from fishermen's catches during the stock thinning operations. The 1980 quality breakdown was based on oysters dragged from the same grounds. The same employee graded the 1977 and 1980 samples to avoid subjective errors resulting from inconsistencies between graders.

Oysters were separated into the Choice, Standard, and Commercial grades commonly used by DFO Inspection Division, and defined as follows:

> Choice - The length of the oyster does not exceed one and three-quarters times its greatest width. The oyster is not abnormally flat, thin-lipped, or malformed.
>
> Standard - The length of the oyster does not exceed twice its greatest width. The oyster is not abnormally flat, thin-lipped, or malformed.
>
> Commercial - The oyster does not meet the requirements of Choice and Standard grades.

An abnormally flat oyster is an oyster which has little depth to its shell, as compared to a cup-shaped oyster and, as a result, contains less meat.

A thin-lipped oyster is one on which the lip is so thin (this is generally new growth) that the handling and/or packing and shipping will invariably break the lip and allow the liquid to escape. This results in a dry or dead oyster on arrival at the market. These are not accepted for any shape.

A malformed oyster is one having a twisted or crooked shell which results in a poor appearance and difficulty in opening.

Statistical calculations were done by computer using the SPSS system (Nie et al., 1975). The significance of the differences observed between the 1977 and 1980 oyster densities and quality breakdowns was tested according to the conservative Scheffe procedure (Kirk, 1968; Winer, 1971). The application of the arcsine transformation (Sokal and Rohlf, 1969) to the percentages did not alter the significance of the differences.

RESULTS

IMPACT OF STOCK THINNING ON POPULATION PARAMETERS

Population structure

The 1977 and 1980 oyster population structures of the Oyster Point, the Hird Point and the Channel beds are shown in Figure 2.

The differences between the 1977 and 1980 structures were tested using a chi-square test applied to size-class representations. The differences on all three beds were not statistically significant: Oyster Point - $P > 0.99$; Hird Point - $P = 0.63$; Channel - $P > 0.99$.

Oyster density, standing stock and standing crop of market-size oysters

The mean oyster densities and 95% confidence limits for all three beds in 1977 and in 1980 are given in Table 2. On the Oyster Point Bed and the Hird Point Bed, the 1980 density was not significantly different from the 1977 density. The 1980 oyster density on the Channel Bed was significantly lower than in 1977.

The lower density found on the Channel Bed in 1977 can probably be attributed to the oyster distribution pattern and

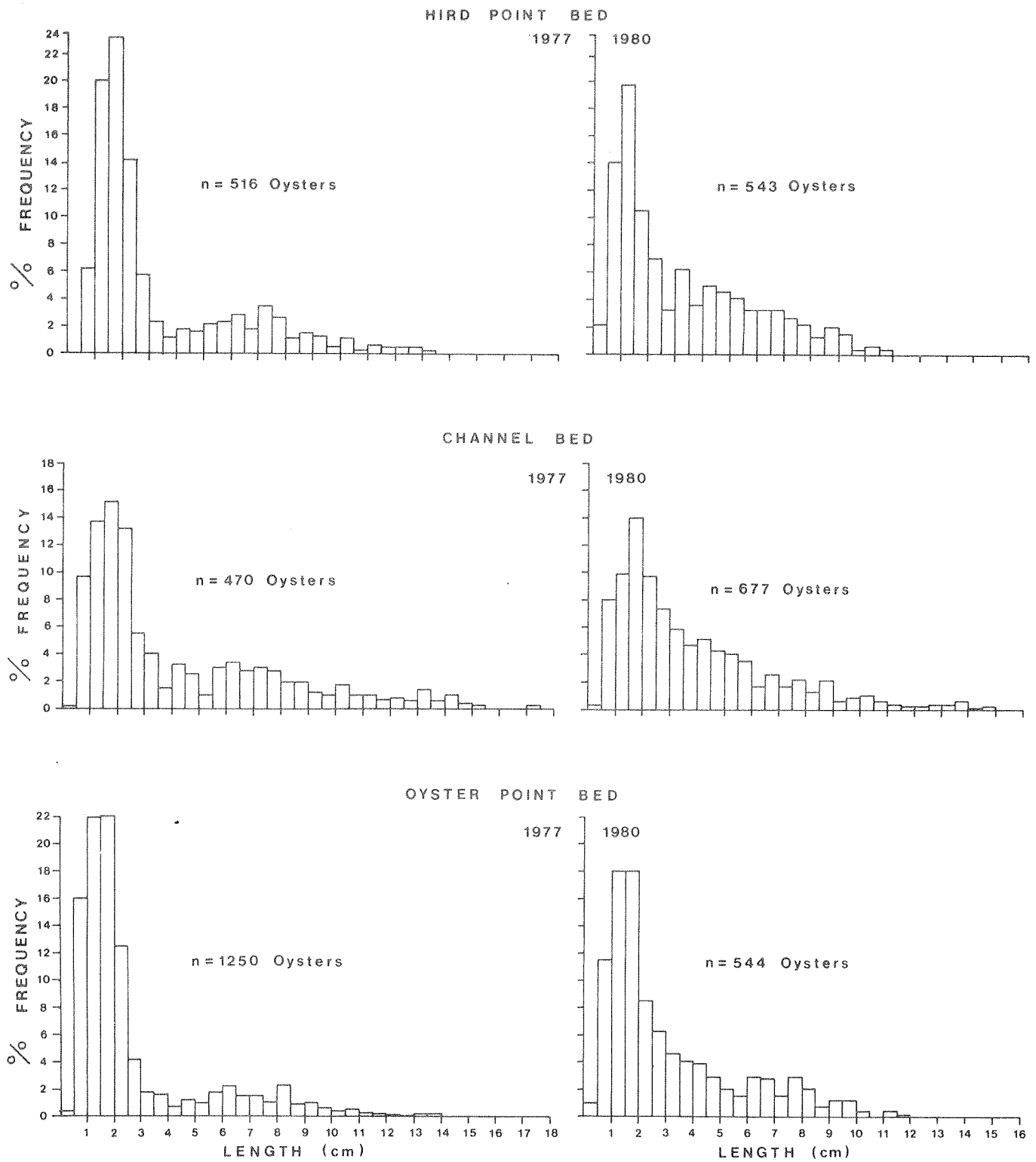

Figure 2. Oyster population structures of the Hird Point Bed, the Channel Bed and the Oyster Point Bed in 1977 and 1980.

Table 2. Mean oyster density, standing stock and standing crop of market-size oysters (± 95% confidence limits) on the Oyster Point Bed, the Hird Point Bed and the Channel Bed in 1977 and 1980.

Parameter	Beds		
	Oyster Point	Hird Point	Channel
Density (n/m^2)			
- 1977	551.8 ± 113.5	408.8 ± 402.9	148.1 ± 122.3
- 1980	550.3 ± 77.4	322.0 ± 66.2	23.3 ± 13.3
Standing stock (millions)			
- 1977	25.7 ± 5.3	9.1 ± 9.0	7.8 ± 6.4
- 1980	25.6 ± 3.6	7.2 ± 1.5	1.2 ± 0.7
Standing crop of market-size oysters (MT)			
- 1977	187.8 ± 38.7	77.8 ± 76.7	117.7 ± 97.2
- 1980	204.9 ± 28.9	49.2 ± 10.1	13.2 ± 7.5

the nature of the substrate. Oyster distribution on that bed is very patchy, with groups of oyster clusters maintaining themselves through successive generations of oysters setting on each other. The Channel Bed bottom is soft mud and lacks the firmness to support exposed oyster shells. As a result, it is hypothesized that no cultch remained on location or in the surrounding areas after part of the existing clusters were removed by the stock thinning operation and that the population may be permanently reduced. If this hypothesis is correct, no further stock thinning should be allowed in beds with similar substrate and oyster population characteristics.

The standing stock estimates (in millions of oysters) are shown in Table 2.

In 1980, the standing stock had returned to its original 1977 level on the Oyster Point Bed. That of the Hird Point Bed appears lower than in 1977, although the large confidence limit of the 1977 estimate renders a firm conclusion risky. The Channel Bed standing stock shows a large reduction since 1977, well in line with the significant density drop noted earlier. Since the 1978-79 reproduction appears to have been normal (Fig. 2), the conclusion is that the area of bottom populated by oysters must have been considerably reduced. No significant amount of fishing was done on these beds between 1977 and 1980.

The estimates of the standing crop of market-size oysters are shown in Table 2. The Oyster Point Bed shows a 17.1 MT increase (9.1%) between 1977 and 1980, which probably reflects a decreased fishing effort on this bed consecutive to the availability of higher quality oysters elsewhere in the same estuary, namely on the receiving grounds (Lavoie and Bryan, 1980). The standing crop variations observed on the Hird Point and Channel beds are in line with the density and standing stock variations discussed earlier.

OYSTER QUALITY

The quality of the oysters found on the three beds subjected to stock thinning was assessed in August 1977 when the operation was conducted and again in August 1980. The results are shown in Table 3.

Although the percentage figures appear to indicate some changes in quality, no statistically significant difference in any grade on any of the three beds was found between 1977 and 1980.

Table 3. Percentage oyster quality breakdown on the Oyster Point, the Hird Point and the Channel beds, and number (N) of oysters graded in 1977 and 1980.

Bed/Quality	Percentages 1977	1980
Oyster Point		
Choice	14.2	13.9
Standard	38.8	43.3
Commercial	47.0	42.8
N	1713	864
Hird Point		
Choice	17.3	23.6
Standard	56.9	45.2
Commercial	25.8	31.2
N	508	1016
Channel		
Choice	3.6	4.8
Standard	18.4	17.8
Commercial	78.0	77.4
N	2226	768

STANDING VALUE OF THE RESOURCE

The overall impact of stock thinning on the standing value of the oyster resource was quantified on the basis of the quality breakdown in 1977 and 1980. The prices paid by buyers to the fishermen for each grade in 1977 and 1980 were used as standards (Table 4).

The values (Table 5) are expressed in constant 1977 dollars to isolate the impact of stock thinning from distortions attributable to inflation and market factors. The values are also expressed in current 1980 dollars to reflect the present unit value of the resource based on current prices which reflect inflation and present market conditions.

The constant dollar increases in unit value on all three thinned beds were very small, the largest of the three amounting to 2.2% in the Oyster Point Bed.

The current (1980) values show increases ranging from 41.4% on the Hird Point Bed to 50.5% on the Channel Bed. The proportionally larger value increase in the Channel Bed reflects the strengthening of prices for the low grade oysters in recent years. Based on present quality breakdown, the Hird Point Bed is where fishermen can harvest the oysters with the highest unit value.

CONCLUSIONS AND DISCUSSION

The 1977 stock thinning operation conducted in the Oyster Point Bed, the Hird Point Bed and the Channel Bed did not significantly alter their oyster population structure nor the quality breakdown of the market-size oysters found on them.

When surveyed in 1980, the Oyster Point Bed and the Hird Point Bed oyster densities were not significantly different from the 1977 densities. The Channel Bed density was significantly lower in 1980.

The oyster unit value expressed in constant dollars shows marginal improvements on all three beds between 1977 and 1980. The Hird Point Bed had the highest unit value in 1977 and retained it in 1980.

The much reduced oyster density and standing stock as well as the lack of quality improvement observed on the Channel Bed suggest that stock thinning should be avoided in the future on beds exhibiting spotty distribution of clustered oysters surrounded by soft mud substrate. Oyster beds of this type probably establish themselves over long periods of time

Table 4. Prices paid for oysters of different quality in western Prince Edward Island in 1977 and 1980 in dollars/kg.

Grade	1977	1980
Choice	.80	1.04
Standard	.54	.78
Commercial	.28	.43

Table 5. Standing value in dollars/Metric Ton of market-size oysters in the Oyster Point, Hird Point and Channel beds in 1977 and 1980.

	Years		
	1977	1980	
Beds	($)	(1977 $)	(1980 $)
Oyster Point	454.72	464.86	666.34
Hird Point	517.90	520.24	732.16
Channel	346.56	351.24	521.58

and seem very vulnerable to population reductions. Post-reproduction stock thinning (August and later months) may be more damaging as the natural cultch left exposed after thinning would have time to either sink into the soft mud or be silted over naturally before the next oyster set in July of the following year.

Stock thinning as a management tool in the Dunk River has not produced the expected lasting oyster quality improvements. The medium-term effects might have been more positive if greater fishing pressure had been applied to the thinned beds.

The results presented herein demonstrate the resilience of the Oyster Point Bed to a 10% stock reduction. This characteristic should theoretically allow that bed to give periodically a substantial quota of seed oysters to populate private shellfish leases or other public fishing areas with good oyster rearing bottom but no natural oyster reproduction. The time interval and the extent of such seed oyster harvestings should be established carefully in order to maintain the self-regeneration capacity of the bed and to avoid possible reductions of natural oyster recruitment in the exploited oyster grounds surrounding that bed. It is our opinion that such an approach can provide inexpensive and already hardened oyster seed to the Prince Edward Island oyster industry.

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