

Oyster Bed Development in the Dunk River, P.E.I., 1975-1980

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ABSTRACT

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Oysters from overcrowded beds were relayed to unpopulated grounds in the Dunk River estuary from 1975 to 1977 in order to improve the shell quality of the relayed oysters and to create new oyster grounds. A 1980 examination of the new population revealed a deficiency of recent year-class representation, an indication of non-self-sustenance. The 1980 total standing crop of marketable oysters was estimated at 60.5 metric tons, and an estimated additional 68 metric tons will become marketable within 2 years. Oyster quality and value are very good on the new grounds, confirming their suitability to rear market-size oysters from seed.

Key Words: oysters, development, population, quality, value.

RÉSUMÉ

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De 1975 à 1977, on a procédé à l'éclaircissage d'huîtres surpeuplées et à la relocalisation des huîtres sur des fonds dénudés de l'estuaire de la rivière Dunk dans le but d'améliorer la qualité de ces huîtres et de créer de nouvelles huîtres. Un examen de celles-ci fait en 1980 a révélé un manque sérieux de classes d'âge récentes dans la population, un indice d'incapacité de la population à s'autoperpétuer. On a estimé à 60.5 tonnes métriques la quantité totale d'huîtres récoltables en 1980, et à 68 tonnes métriques la quantité d'huîtres qui deviendront récoltables dans les deux prochaines années. La qualité et la valeur marchande des huîtres des nouvelles huîtres sont élevées, ce qui en confirme la capacité de produire des huîtres récoltables à partir d'huîtres de semence.

INTRODUCTION

The Dunk River estuary opens into Summerside Harbour, Prince County, Prince Edward Island (Fig. 1). The estuary 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 was initiated in Summerside Harbour. One objective of the project was to increase the total area of oyster-producing bottom by relaying oysters from overcrowded areas of the natural oyster beds to unpopulated grounds. It was also hoped that spreading the new grounds at low density would improve the shell quality of the relayed oysters. These techniques have been recommended by several authors (Medcof 1961; MacKenzie 1975); one successful application in the Maritimes has been documented in a recent report (Lavoie and Bryan 1980) which quantifies the short term impact of relocation on oyster quality and value.

This report evaluates the present status of the new oyster grounds created by the relocation project. It examines the structure of the oyster population living on the new grounds to determine whether these populations are self-sustaining, presents oyster reproduction records and an oyster growth curve for the estuary, and gives estimates of present and future standing crops of market-size oysters on the basis of the present population structure and growth curve. Finally, it evaluates the quality of the present standing crop and assesses its value.

MATERIALS AND METHODS

The location of the new oyster grounds (DR75, DR76 and DR77) in relation to the natural oyster bed within the Dunk River estuary is shown in Figure 1. The grounds were selected and marked by SCUBA divers who ensured that the bottom was firm enough to allow oysters to grow a desirable shell and that the water was deeper than 1 metre at low tide bearings to avoid potential ice damage during the winter. Sextant bearings of the corners of the grounds were recorded for area calculations and future relocation. The grounds did not bear any significant amount of oysters before the relaying operations.

In 1975, 3.6 million oysters of all sizes (range: 0-15 cm) were spread on 6.3 hectares of bottom (DR75). In 1976, 3.6 million oysters were spread over 6.1 hectares of bottom (DR76). In 1977, 6.2 million oysters were spread over 7.1 hectares of bottom (DR77). After transfer mortality, the

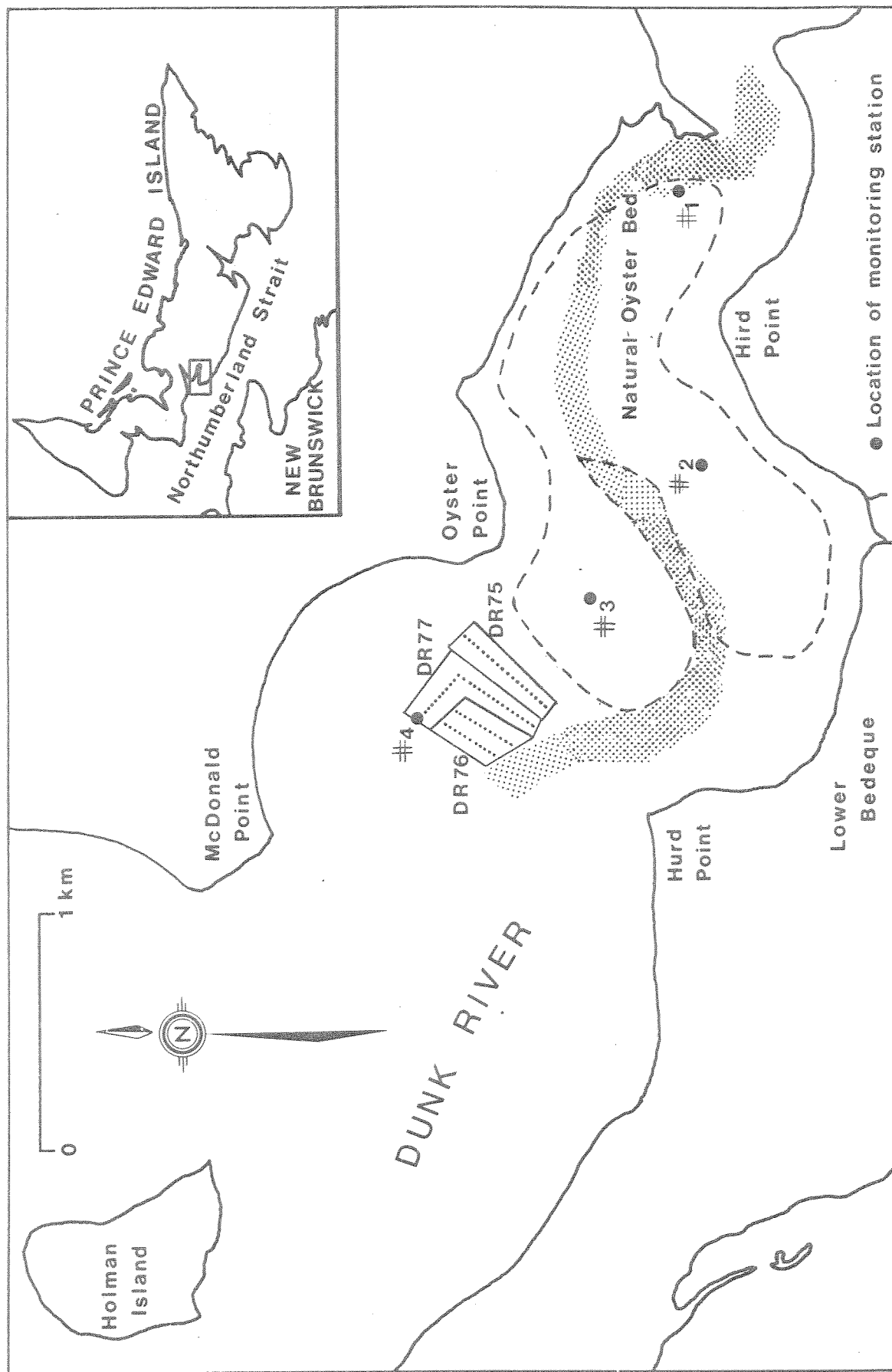


Figure 1. Location of the new oyster grounds (DR75, DR76 and DR77) and of the natural oyster bed within the Dunk River estuary. The shaded areas show the location of the river channel. Dotted lines on DR75, DR76 and DR77 show the 1980 sampling transects.

final oyster density was 41.9 oysters/m² on DR75 and 52.9 oysters/m² on DR76 (Lavoie and Bryan 1980). The final oyster density on DR 77 was 81.6 oysters/m².

The 1980 sampling of the oyster populations was done by throwing a 1 m² grid over the side of the boat on each side of temporarily marked transects (Fig. 1). A diver collected all live oysters, surface shell and other material from within the grid. A total of 78 samples were collected from the new grounds, giving a sampling fraction of 1:2,500.

Laboratory treatment of the samples first involved sorting of oysters from other shellfish, shells, and other bottom material. Length measurements of all oysters were taken with a caliper along the longest axis of the shell. All live oysters older than one year were measured. Spat of the year was disregarded. Weight of empty shell in each sample was recorded.

Oyster quality breakdown based on Choice, Standard and Commercial grades was determined according to the criteria commonly used by DFO's Inspection Division and described in detail in a previous report (Lavoie and Bryan 1980).

The 1970 oyster spatfall data are oyster spat counts on the cup side of scallop shells exposed for periods of two weeks at 0.3, 1.2 and 2.1 metres below the surface of the water at four locations within the Dunk River estuary (Fig. 1). The shells were approximately 10 centimetres in height; they were held on rigid racks suspended vertically in the water column from a float.

Statistical calculations were completed with the SPSS system (Nie et al. 1975).

RESULTS

OYSTER POPULATION STRUCTURE ON THE NEW GROUNDS

The present oyster population structure on DR75, DR76 and DR77 is illustrated by the length-frequency histograms shown in Figure 2, which also shows the proportion of market-size oysters (length > 7.6 cm) within the population.

The oyster population on all three grounds shows low representation of young individuals, especially on DR76 and DR77. Such an unbalanced structure indicates a severe recruitment problem on these two grounds. The DR75 population structure contains a higher proportion of young individuals.

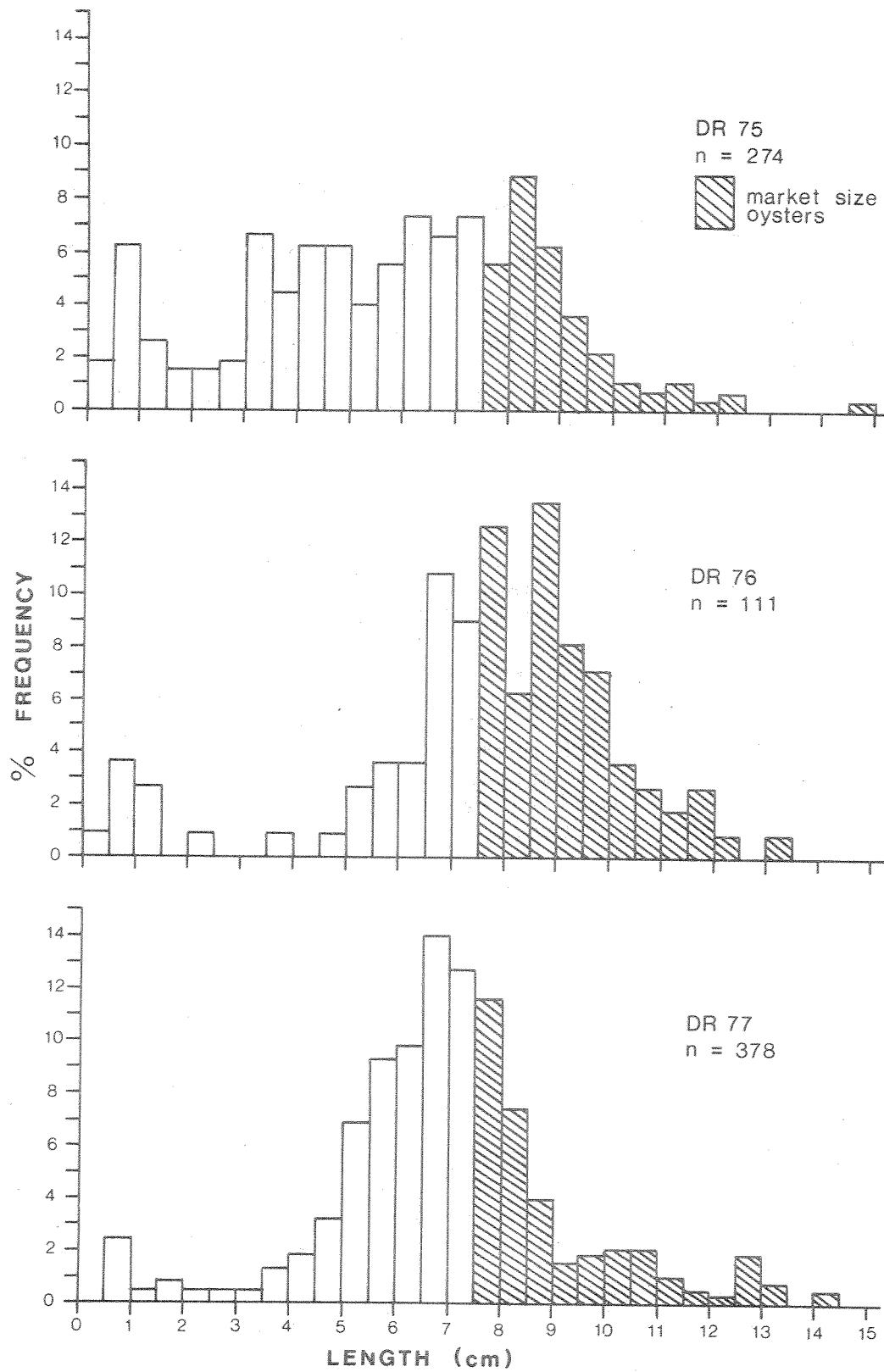


Figure 2. Length-frequency distribution of the oysters on DR75, DR76 and DR77.

However, most young oysters were collected at two sampling stations located in the northeastern portion of DR75, near Oyster Point (Fig. 1). This indicates better natural reproduction in that area of DR75 either on the relayed oysters or possibly on some natural patch of oysters that may have existed there prior to the project.

The population structure (Fig. 3) of the self-sustaining Oyster Point Bed (Lavoie and Bryan 1981) was compared with the structures of DR75, DR76 and DR77 by means of a chi-square applied to respective length class representations. All three were found very significantly different ($P < .005$) from the structure of the Oyster Point Bed, a probable reflection of the low prerecruit representation on the new grounds.

OYSTER REPRODUCTION IN THE DUNK RIVER ESTUARY

The natural oyster bed of the Dunk River estuary is self-sustaining and has been the single most important source of natural market-size oysters in P.E.I. for a long time under the present spring fishery exploitation regime. It is a widely accepted view that such a regime actually increases spat fixation because tong fishing from May 1 to July 15 exposes much clean cultch for the mature larvae to set on around mid-July.

As recruitment of young oysters appears deficient on the new grounds, an examination of the possible causes of the deficiency is in order. The first possible cause would be the absence of oyster larvae in the water column over the area of the new grounds. To verify this hypothesis, oyster spatfall monitoring data collected at four stations within the Dunk River estuary in 1970 were extracted from the Canadian Department of Fisheries unpublished records and presented in Table 1.

The monitoring stations number 1-3 were located within the natural oyster bed and number 4 was located on the landward downstream portion of DR77 (Fig. 1).

The monitoring period was July 16 to August 12 which is typically the oyster spatfall period in Prince Edward Island. The results indicated the presence of enough oyster larvae throughout the water column to produce a fairly abundant set ($n/\text{shell} > 50$) at the 1.2 metre and 2.1 metre levels. Since a set was recorded on that portion of DR77 which is furthest downstream from the natural bed, it can be reasonably assumed that larvae were present over the entire area of the new grounds and that an absence or rarity of oyster larvae was not the cause of the poor recruitment of young oysters on the new grounds.

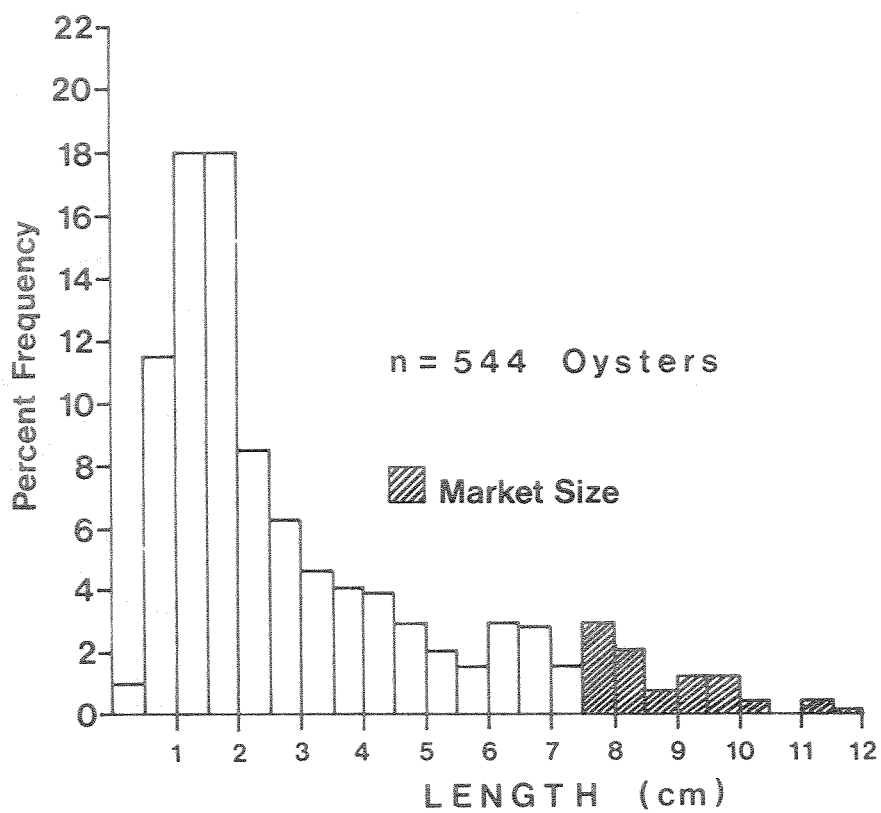


Figure 3. Length-frequency distribution of oysters on the Oyster Point Bed, Dunk River, P.E.I., in 1980.

Table 1. Total oyster set on the cup side of 10 cm scallop shells at four stations in the Dunk River estuary in 1970.

Station	Level (m/ft)	Spatfall Period			Total Set
		July 16-29	July 22- Aug. 5	July 29- Aug. 12	
1	0.3/1'	53	379	32	464
2	0.3/1'	221	252	1	474
3	0.3/1'	58	85	58	201
	1.2/4'	196	177	278	651
4*	0.3/1'	1	1	2	4
	1.2/4'	14	285	11	310
	2.1/7'	136	5	129	270
Total		679	1184	511	

*The 2.1 metre rack used at station #4 proved to be too long as water depth at low tide was less than 2.1 metres. This caused the rack to tilt over at low tide. The spat counts for station #4 should therefore not be interpreted as belonging for certain to the reported levels since the levels may have been different if the set took place at low tide.

Another possible cause of oyster recruitment failure is a lack of cultch on the new grounds. However, shell weights collected during the 1980 sampling were 1.1 ± 0.58 kg/m² on DR75, 0.64 ± 0.25 kg/m² on DR76 and 0.74 ± 0.63 kg/m² on DR77. Such shell weights are within cultch availability ranges found on the Dunk River natural self-recruiting oyster beds (0.78 ± 0.60 kg/m²), thus eliminating that possibility as a cause of poor recruitment on the new grounds.

Early natural mortality of young oysters was considered as a possible cause of the prerecruit deficiency within the new grounds oyster population. Spat counts were made in late September 1976 on 20, 2 kg samples of planted shells from the new grounds and on 20, 2 kg samples of similar shells from a similar area of the neighbouring Wilmot River. Spat counts per kg of shells (\pm S.D.) were 3.3 ± 3.7 on the new grounds and 125.3 ± 48.3 in the Wilmot River. It is concluded that if early mortality of young oysters is responsible for the prerecruit deficiency on the new grounds, such mortality must take place within the first two months after settlement.

OYSTER GROWTH IN THE DUNK RIVER ESTUARY

The American oyster grows slowly in the Maritimes; individuals reach the marketable size (7.6 cm) in 4-7 years (Medcof 1961). In Caraquet Bay, New Brunswick, oysters become marketable during their sixth full growth season, not including the year of birth (Lavoie 1977).

In order to extrapolate predictions of future standing crops on the basis of the present length-frequency distributions, a Von Bertalanffy growth curve (Ricker 1975) was fitted on 664 length-at-age data obtained from oysters collected from the exploited portion of the natural oyster bed (Fig. 4). The parameters of the equation:

$$L_t = L_{\infty} (1 - e^{-K(t-t_0)})$$

are as follows:

Parameter	95% confidence limits
K = 0.186	0.142 - 0.230
L _∞ = 15.3	13.4 - 17.2
t ₀ = 0.159	-0.004 - 0.323

The curve indicates that oysters reach the marketable size of 7.6 cm within 4-5 years in the Dunk River estuary.

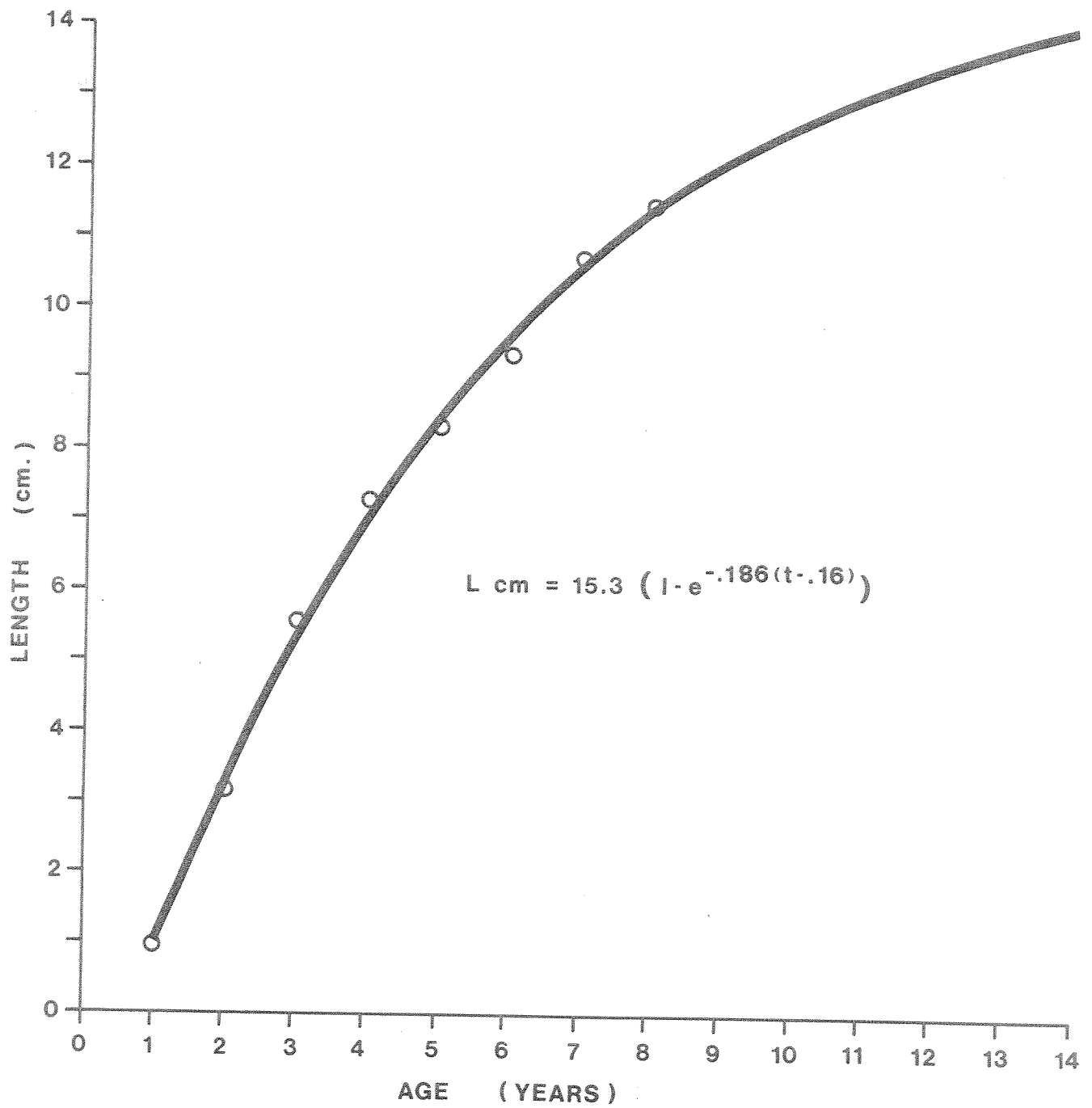


Figure 4. Oyster growth in the Dunk River estuary.

OYSTER DENSITY AND STANDING CROP ESTIMATES

The present oyster densities, the percentage of market-size oysters within the population, and the 1980 standing crop estimates for DR75, DR76 and DR77 are given in Table 2. Oyster density is low on all three beds. Large standard deviations indicate wide ranging densities, especially on DR75. The high percentages of market-size oysters within the population reflect the low recruitment of young individuals discussed earlier and indicate that the grounds have probably been little exploited in 1980 and perhaps in 1979. This is especially true for DR76. It is hardly surprising, considering the very low oyster density which probably makes this ground's yield/effort unattractive to fishermen.

Estimates of recruitment to the harvestable standing crop in 1981 and 1982 were calculated on the basis of the present population structure and the growth curve provided earlier, assuming an annual natural mortality $A = 0.1$ among the prerecruits (Table 2). The estimates show that the standing crop of harvestable oysters will more than double on DR75 and DR77 within the 1981-82 period. On the basis of the present population structure on the new grounds (Fig. 2), it is unlikely that the standing crop will improve after 1982, except perhaps on some inshore portions of DR75.

OYSTER QUALITY AND VALUE

The quality of the market-size oysters on DR75, DR76 and DR77 in 1980, and the standing unit value (\$/MT) of the oysters on each bed are given in Table 3.

The overall oyster quality is very high on DR75 and DR76 with only an insignificant proportion of the market-size oysters in the undesirable Commercial grade. A comparison with quality breakdowns published earlier for these two beds (Lavoie and Bryan 1980) indicates a continuous quality improvement process translated by a 20.8% increase in Choice grade representation between 1977 and 1980 on DR75, and a 33.9% increase in Choice grade between 1978 and 1980 on DR76.

The standing unit value of market-size oysters on all three new grounds is high, the highest value on DR75 and the lowest on DR77, reflecting the constant quality improvement which seems to begin with the relaying of the oysters to the new grounds. When compared with the standing values calculated earlier (Lavoie and Bryan 1980), the value of market-size oysters has increased by 50% on DR75 since 1977 and by 58% on DR76 since 1978.

Table 2. Oyster density, percentage of market-size oysters in the population and standing crop in 1980, and estimates of market-size oysters recruitment in 1981 and 1982 on DR75, DR76 and DR77.

Parameter	DR75	DR76	DR77
Density n/m ² ± S.D.	9.8 ± 15.4	4.3 ± 2.5	15.1 ± 12.0
Percentage of m.s. oysters	30.7	60.3	35.8
Standing crop (1980) metric tons ± 95% C.L.	15.4 ± 8.1	12.8 ± 2.5	32.3 ± 8.6
Recruitment estimates in metric tons			
- 1981	9.6 ± 5.0	4.5 ± 0.9	28.7 ± 7.6
- 1982	8.9 ± 4.7	1.2 ± 0.2	15.1 ± 4.0

Table 3. Quality and 1980 standing unit value of the market-size oysters on DR75, DR76 and DR77.

Bed	Quality (%)				Value \$/MT
	N	Choice	Standard	Commercial	
DR75	802	80.0	17.7	2.3	979.95
DR76	721	76.0	21.2	2.8	967.80
DR77	1010	50.3	37.4	12.3	867.73

CONCLUSIONS AND DISCUSSION

The oyster populations on DR75, DR76 and DR77 show a serious deficiency of young individuals, especially when compared with the population of the neighbouring natural oyster bed. That deficiency indicates that the new oyster grounds are not self-sustaining at present, even though limited numbers of young individuals are present within these populations.

The presence of these young individuals and the results of a separate spatfall monitoring study indicate that enough larvae are present over the area to provide a natural set ensuring self-perpetuation. Low recruitment of young oysters could be linked with low cultch availability, siltation of cultch at setting time, or, more likely, to a combination of both factors. First-year mortality of the new recruits, either through predation or over-the-winter siltation may also be a factor. Our limited observations recorded by diving suggest that siltation of the cultch at setting time was a most probable limiting factor. More specific studies are required before firm conclusions can be drawn.

The present total standing crop of market-size oysters on the new grounds is estimated at 60.5 metric tons. Based on a 4-5 year growth period to market-size (7.6 cm), and an annual mortality rate (A) of 0.1, recruitment to the fishery is estimated at 42.8 metric tons in 1981 and 25.2 metric tons in 1982.

Oyster quality and value are very good on all three new grounds with the best quality on DR75, the ground which was established first. This confirms the suitability of the new grounds for rearing high quality market-size oysters from seed. The low recruitment level discussed earlier could be an advantage, since culling and cleaning time for the harvested oysters would be reduced in the absence of young oysters attached to the market-size ones.

An exploitation strategy based on the present knowledge of the new oyster grounds could be either to continue efforts to develop them as self-sustaining oyster beds or to utilize them as rearing grounds. The former alternative could involve cultch cleaning and spreading of new cultch before or during spatfall to improve natural recruitment on the grounds. Concurrently, research on extent and causes of natural mortality-at-age should be conducted. The latter alternative would involve periodic stocking of the areas with oysters from the overcrowded areas of the natural beds and/or seed produced for that purpose.

Since both strategies appear possible from a biological standpoint, a strategy decision should ideally involve input from the industry and cost/benefit analyses, which are both beyond the scope of this report.

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REFERENCES

- Lavoie, R.E. 1977. The oyster population of the public fishing area, Caraquet Bay, New Brunswick. Fisheries and Marine Service Tech. Rep. 735, Halifax, N.S. 39 p.
- 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.
- 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.
- MacKenzie, C.L., Jr. 1975. Development of a program to rehabilitate the oyster industry in Prince Edward Island. Mar. Fish. Rev., 37(3): 21-35.
- Medcof, J.C. 1961. Oyster farming in the Maritimes. Bull. 131, Fish. Res. Bd Can., Biological Station, St. Andrews, N.B. 158 pp.
- Nie, N.H., C.H. Hull, J.G. Jenkins, K. Steinbrenner, and D.H. Bent. 1970. Statistical package for the social sciences. McGraw-Hill Book Co., New York.
- Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Bd Can. 191: 382 p.