Shellfish Monitoring Network in Atlantic Canada 1996-2001: Temperature, growth, condition and survival.

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Canadian Data Report of Fisheries and Aquatic Sciences

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Numbers 1-25 in this series were issued as Fisheries and Marine Service Data Records. Numbers 26-160 were issued as Department of Fisheries and Environment, Fisheries and Marine Service Data Reports. The current series name was changed with report number 161.

Rapport statistique canadien des sciences halieutiques et aquatiques

Les rapports statistiques servent de base à la compilation des données de classement et d'archives pour lesquelles il y a peu ou point d'analyse. Cette compilation aura d'ordinaire été préparée pour appuyer d'autres publications ou rapports. Les sujets des rapports statistiques reflètent la vaste gamme des intérêts et politiques de Pêches et Océans Canada, notamment la gestion des pêches, la technologie et le développement, les sciences océaniques et l'environnement aquatique, au Canada.

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Les rapports statistiques sont produits à l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement d'origine dont le nom figure sur la couverture et la page du titre.

Les numéros 1 à 25 de cette série ont été publiés à titre de Records statistiques, Service des pêches et de la mer. Les numéros 26-160 ont été publiés à titre de Rapports statistiques du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom de la série a été modifié à partir du numéro 161.

Canadian Data Report of
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1.0 INTRODUCTION

The standardized Shellfish Monitoring Network (SMN) in the southern Gulf of St. Lawrence was proposed to track growing conditions within major cultivation bays with the objective to better understand the naturally-occurring variability (both spatial and temporal) in shellfish growing conditions. An understanding and accounting for such variability was considered important in order to gauge the effectiveness of bay management decisions. The SMN protocol consists of deploying juvenile blue mussels (*Mytilus edulis*) and american oysters (*Crassostrea virginica*) at fixed stations across the southern Gulf in the spring and thereafter to monitor their growth and meat content until the onset of winter. The development of the Shellfish Monitoring Network (SMN) in 1996 and 1997 was considered successful by the Department of Fisheries and Oceans as well as its partners.

This report presents the water temperature, shellfish (American oysters only) growth and condition for all sample stations from 1996 to 2001 in a summarized graphic format. Survival rates of oysters have been compiled in tabular format. A total of ten sites have been monitored between 1996 and 2001.

2.0 MATERIALS AND METHODS

The methodology, described in details by Sonier *et al.* 2011, has remained relatively consistent throughout the study period. Juvenile oysters were placed in standardized cage systems (Figure 1.) and immersed at the study sites. The oysters were placed in individual compartments (32 oysters per site) for growth monitoring (Figure 2) and in a common Vexar® bag (100 oysters) for the condition index sampling. Temperatures probes (Minilogs®, Vemco Ltd. Canada) were affixed to the cages and were programmed to record temperatures on an hourly basis. Cages were generally deployed for the duration of the ice-free period (May to November) in various sites in Atlantic Canada. Periodic sampling consists in measuring the length (maximum distance between the umbo and the shell margin; Figure 2) of the oysters in the individual compartments with calipers, as well as removing a sub-sample of oysters from the Vexar® bag for condition index analysis. The cage systems are retrieved at the end of the autumn season. Each year the oysters are replaced with new juvenile oysters.

The only difference in the methodology described by Sonier *et al.* 2011 was a change in the size of the oysters used. Since 1996-1997, new markets for cultured oysters (i.e. cocktail

market; typically at 64 mm) in shellfish growing areas in the Gulf of St. Lawrence have reduced the required market grow-out time. These changes have made it difficult to acquire oysters with shell lengths of 60-65 mm. Consequently, the SMN has used oysters with a mean shell length of 50 mm since 1998.

3.0 DATA PRESENTATION

Survival rates of oysters for all sites and years are presented in Table 1. The temperatures, shell lengths, growth rates, and condition indices from each study site are presented in Figures 3 to 42. Temperatures are presented as the mean daily temperature for all the years of monitoring. Variability is expressed as the maximum and minimum mean daily temperatures recorded within all years (highest daily means and lowest daily means). Mean shell lengths from the deployment of the oysters in May, until their recovery in November, are shown for each year and site. Growth rates are calculated each year based on the individual growth differences between the deployment shell length and the final length at recovery. Condition indices are shown to represent the seasonal and yearly changes in meat yield proportions. The error bars in the shell lengths, growth rates and condition indices figures represent the variation within the sample and are expressed as confidence intervals (0.95%). Survival rates (%) were determined from the number of living oysters in the individual compartments at the end of the season.

4.0 ACKNOWLEDGEMENTS

The success of the SMN is due in large part to the extensive partnerships with many individuals and organizations. Fisheries and Oceans Canada thanks all the participants that provided support to the SMN including the aquaculture industry throughout the Gulf of St. Lawrence, Provincial Fisheries and Aquaculture Departments in New Brunswick, Nova Scotia, Prince-Edward-Island and Québec.

5.0 REFERENCE

R. Sonier, K. LeBlanc, M. Hardy, M. Ouellette, L.A. Comeau and T. Landry. 2011. Development of a Shellfish Monitoring Network in Atlantic Canada 1996-1997. Can. Tech. Rep. Fish. Aquat. Sci. 2944 : viii + 28pp.

6.0 APPENDIX

Table 1: Survival rates (%) of the 32 oysters placed in condo cages during a six month exposure (May to November) at all sample stations from 1996-2001.

Site (Province)	1996	1997	1998	1999	2000	2001	Mean survival (%)
Caraquet (NB)	100	93.8	96.9	96.9	n/a	96.9	**96.9**
Cocagne (NB)				96.9	96.9	96.9	**96.9**
Richibouctou (NB)	96.9	90.6	100	96.9	100	93.8	**96.4**
Shemogue (NB)	100	93.7	96.9	96.9	n/a	96.9	**96.9**
Ellerslie (PEI)	96.9	90.6	90.6	100	65.6		**85.4**
Tatamagouche (NS)	96.9	96.9	87.5	93.8	53.1	96.9	**87.5**
St. Mary's Bay (NS)					96.9	90.6	**93.8**
Wedgeport (NS)			100	100	87.5		**95.8**
Bassin aux Huîtres (Îles de la Madeleine, QC)					96.9	100	**98.4**
Cap Vert (Îles de la Madeleine, QC)		100	100	90.6	100	100	**98.1**

Notes: The symbol "n/a" means that data was not available during the study period, whereby the cage was lost during the study period.

Figure 1: Photograph of oyster monitoring cage used for the Shellfish Monitoring Network. This study method is representative of oyster bottom-culture (Sonier *et al*. 2011).

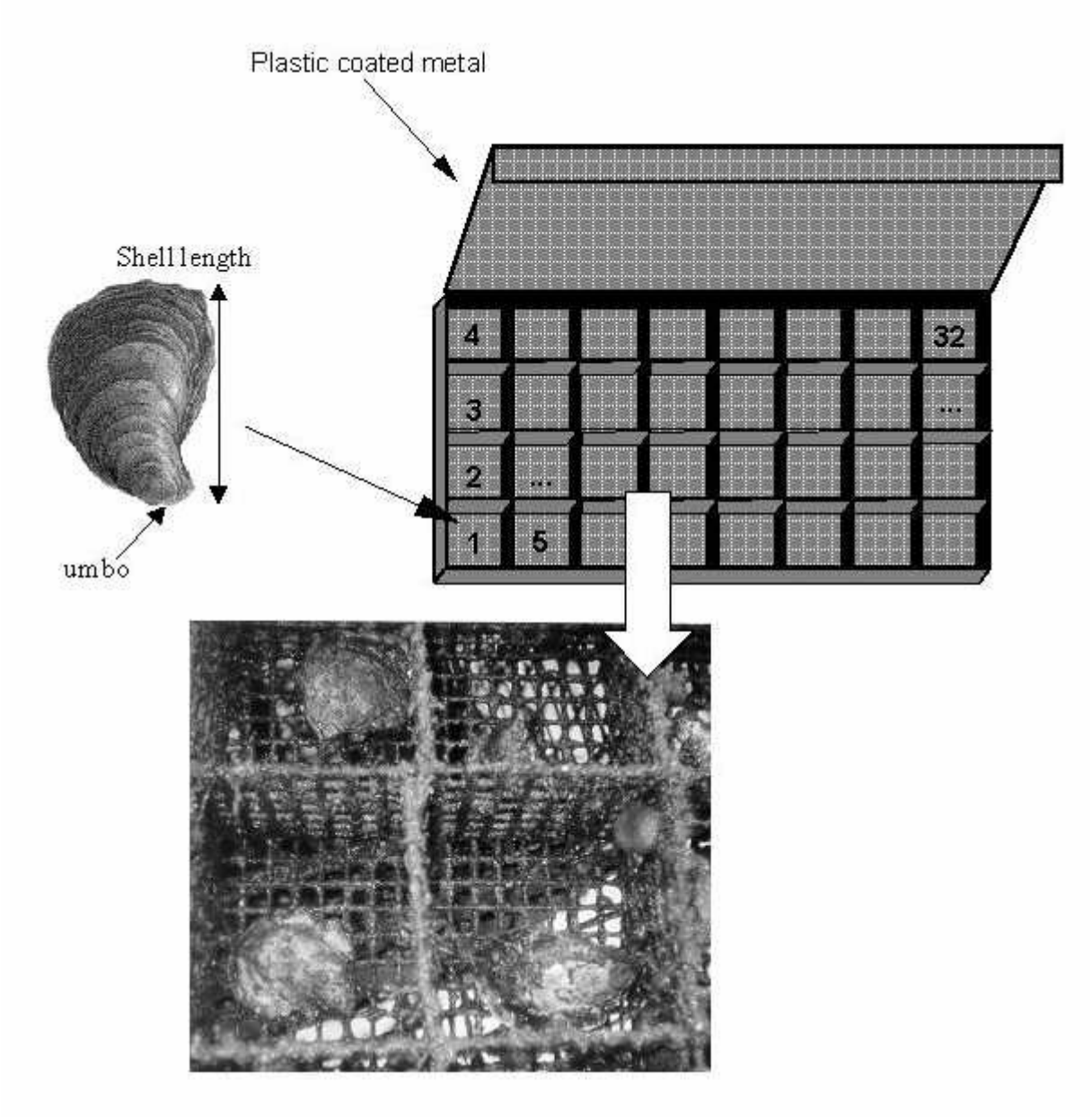

Figure 2: Picture of a condo cage used for measuring individual oyster growth. The condo is placed within the oyster monitoring cage (Sonier *et al*. 2011).

6.1 Caraquet Bay (NB)

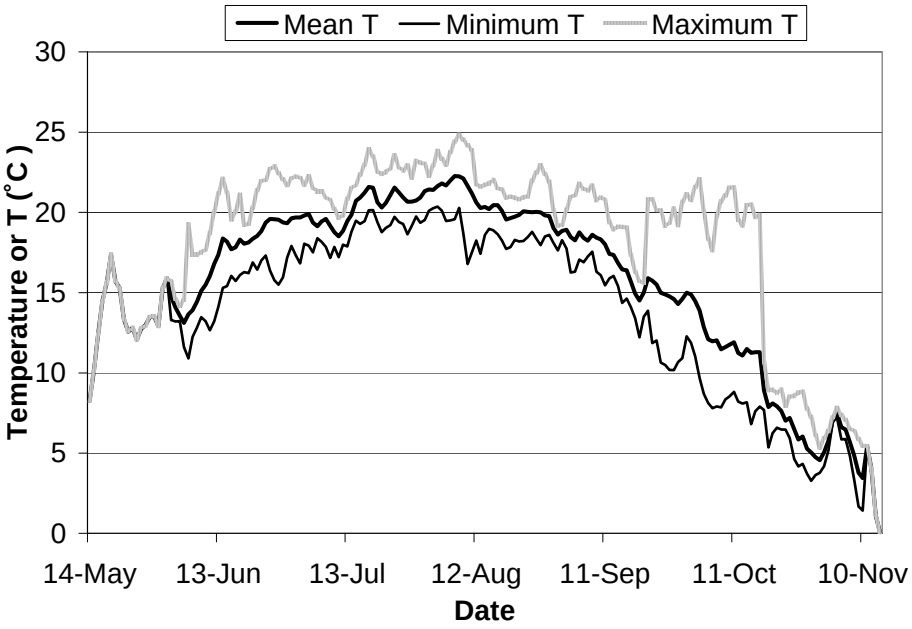

Figure 3: Average daily water temperature in Caraquet Bay NB, from 1996 to 2001.

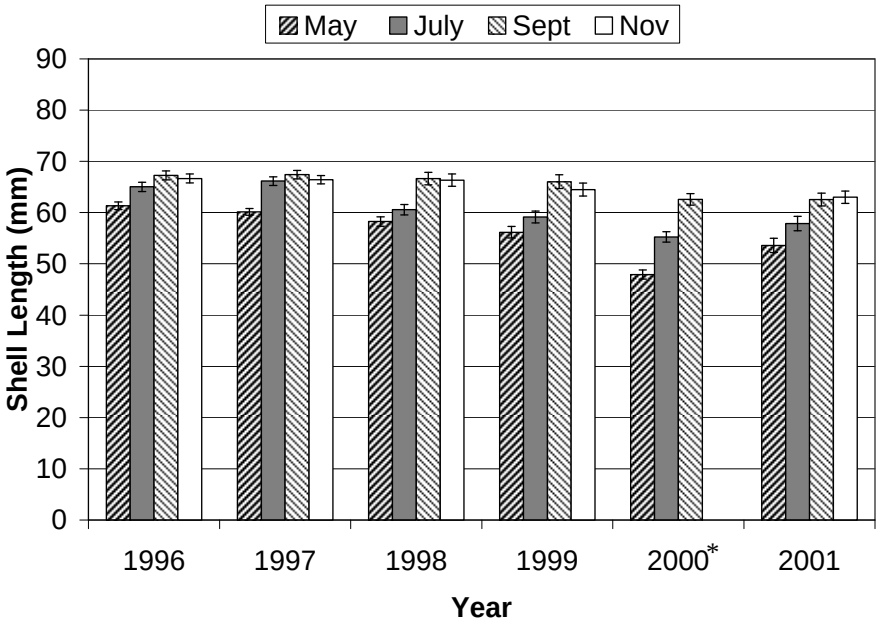

Figure 4: Average shell length monitored in May, July, September and November in Caraquet Bay NB, from 1996 to 2001. *Note: The oyster monitoring cage was lost in September 2000.

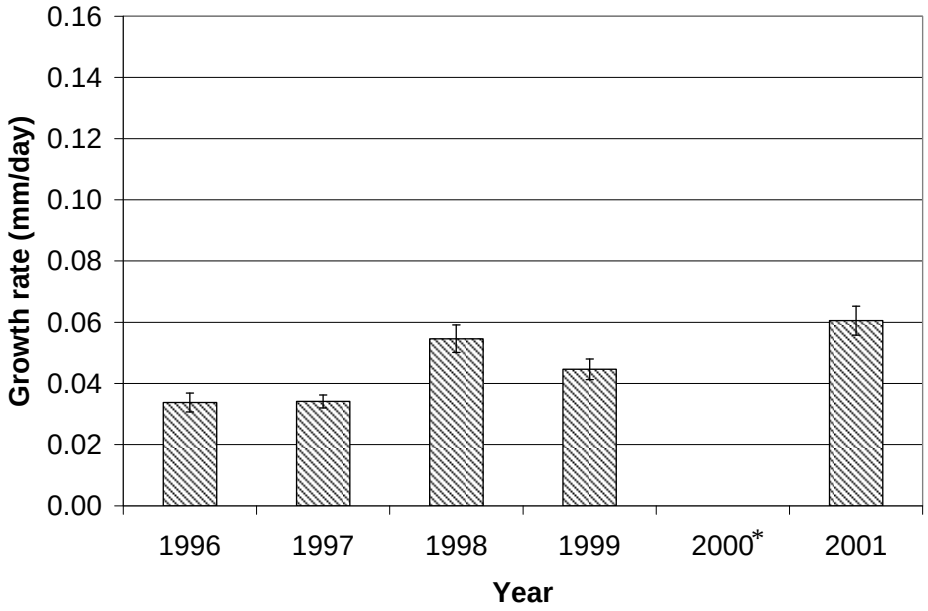

Figure 5: Average shell growth rate from May to November in Caraquet Bay NB, from 1996 to 2001. *Note: The oyster monitoring cage was lost in September 2000.

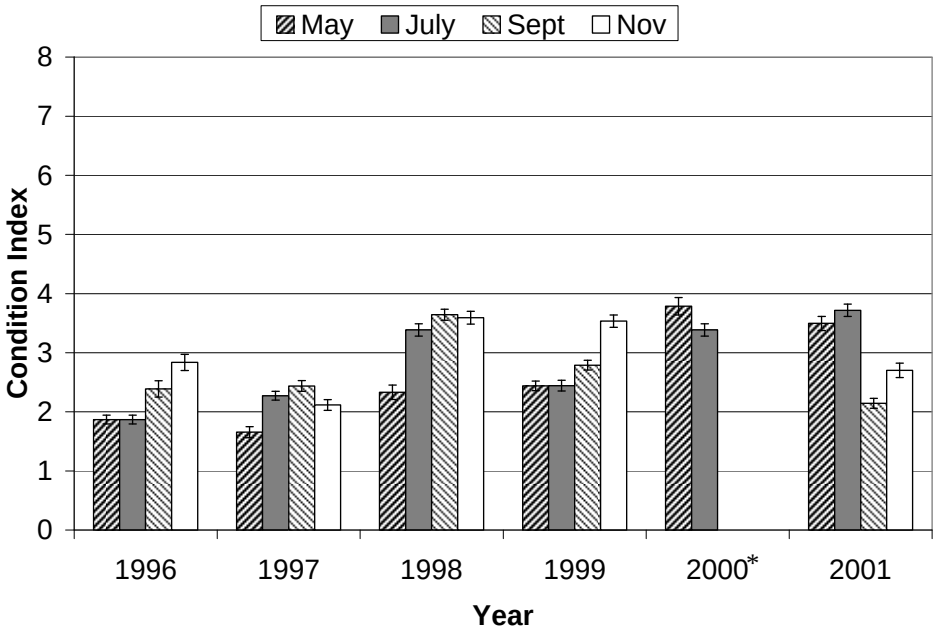

Figure 6: Average oyster condition index from May to November in Caraquet Bay NB, from 1996 to 2001. *Note: The oyster monitoring cage was lost in September 2000.

6.2 Cocagne (NB)

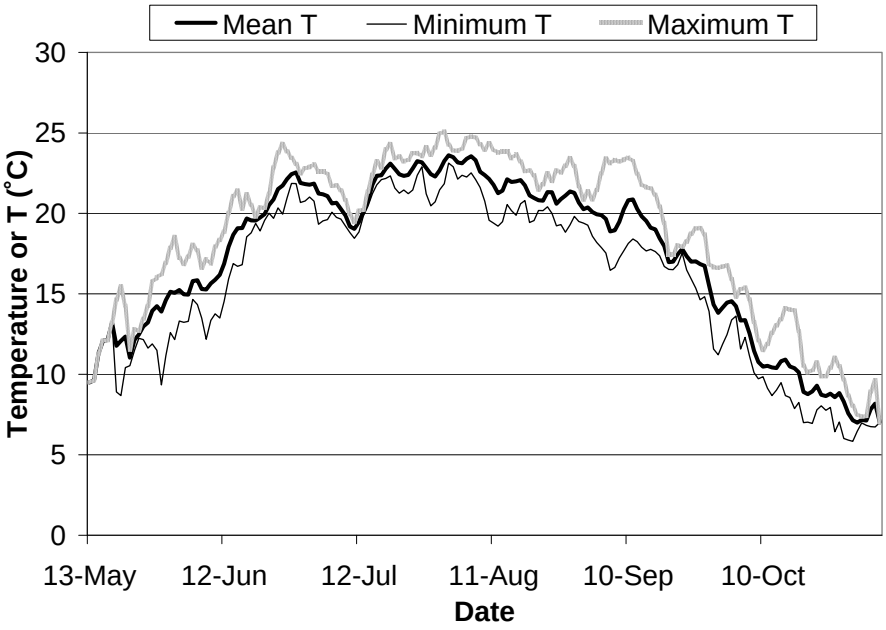

Figure 7: Average daily water temperature in Cocagne NB, from 1999 to 2001.

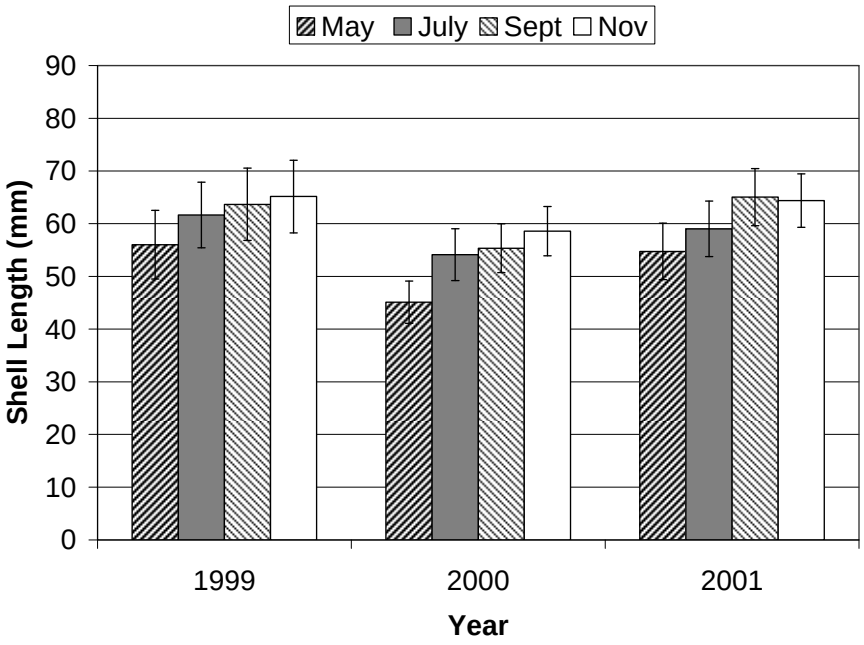

Figure 8: Average shell length monitored in May, July, September and November in Cocagne NB, from 1999 to 2001.

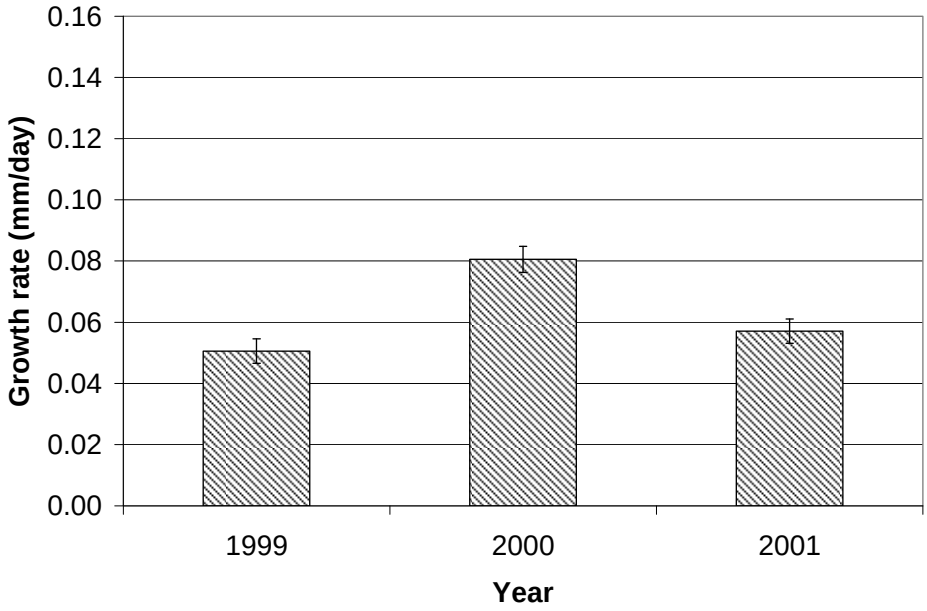

Figure 9: Average shell growth rate from May to November in Cocagne NB, from 1999 to 2001.

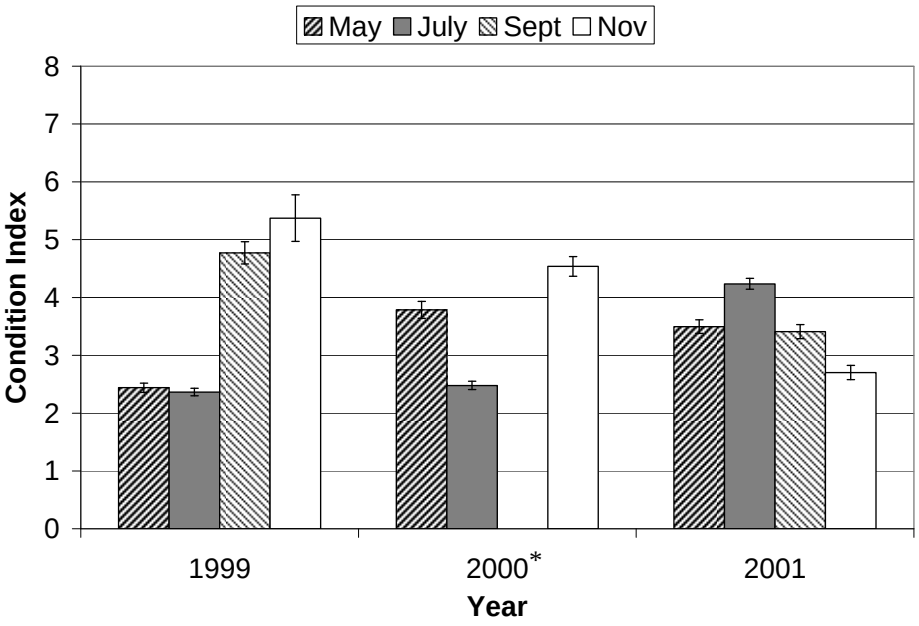

Figure 10: Average oyster condition index from May to November in Cocagne NB, from 1999 to 2001. *Note: Samples for condition index were not available for September 2000.

6.3 Richibouctou (NB)

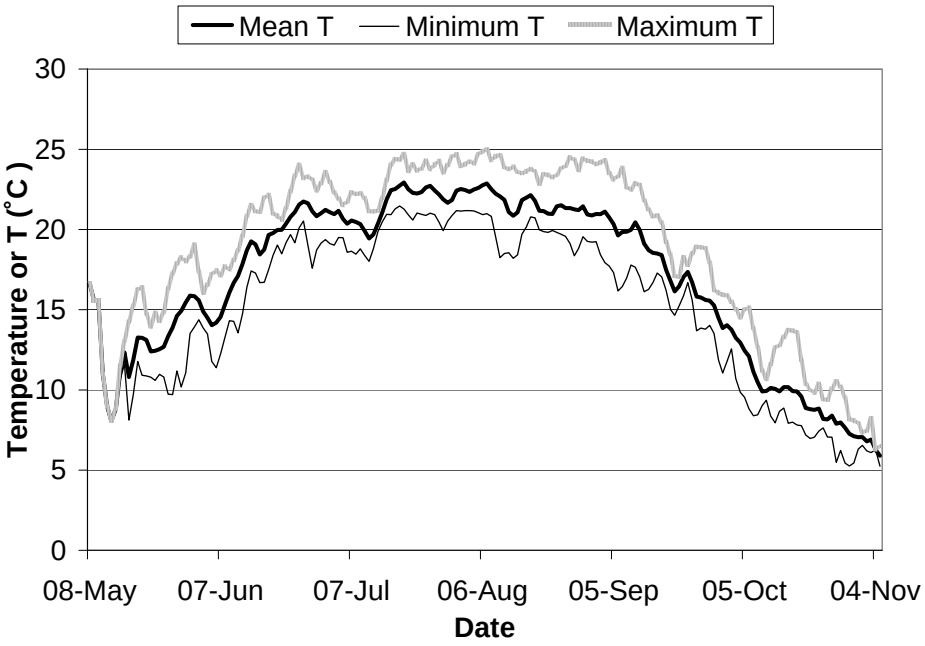

Figure 11: Average daily water temperature in Richibouctou NB, from 1996 to 2001.

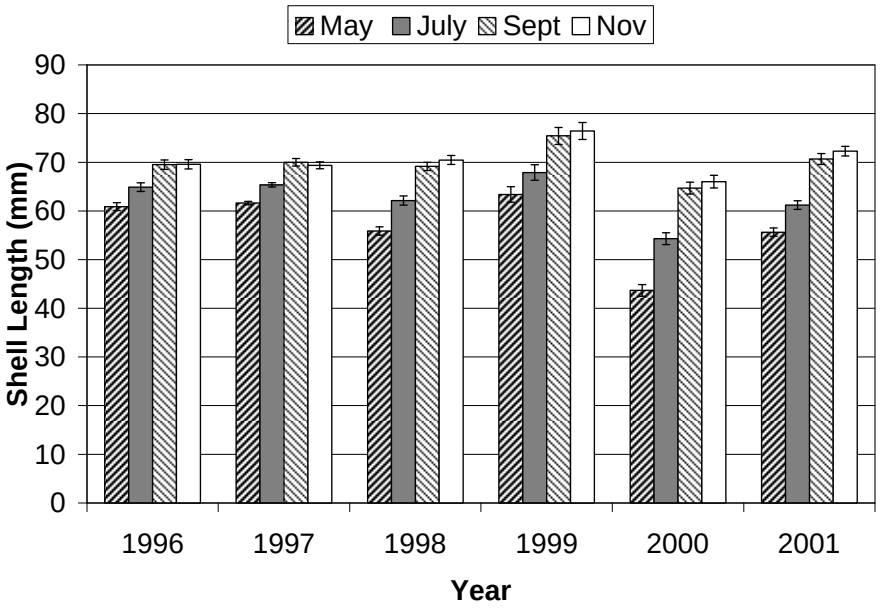

Figure 12: Average shell length monitored in May, July, September and November in Richibouctou NB, from 1996 to 2001.

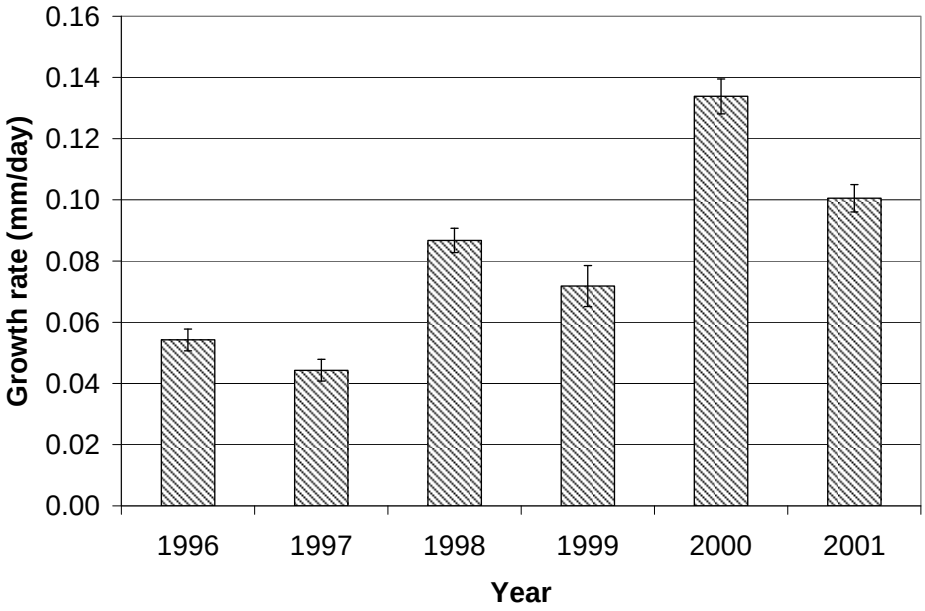

Figure 13: Average shell growth rate form May to November in Richibouctou NB, from 1996 to 2001.

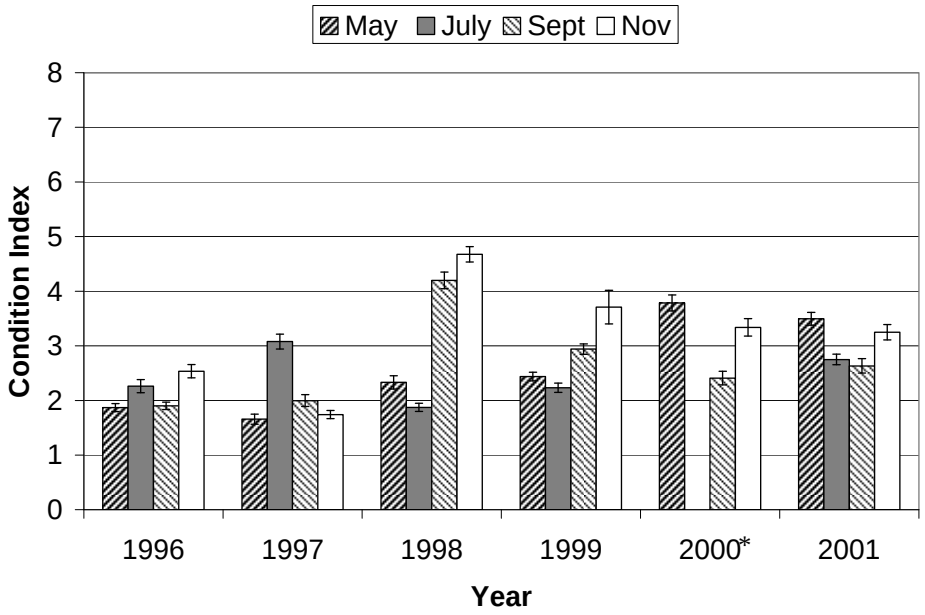

Figure 14: Average oyster condition index from May to November in Richibouctou NB, from 1996 to 2001. *Note: Samples for condition index were not available for July 2000.

6.4 Shemogue (NB)

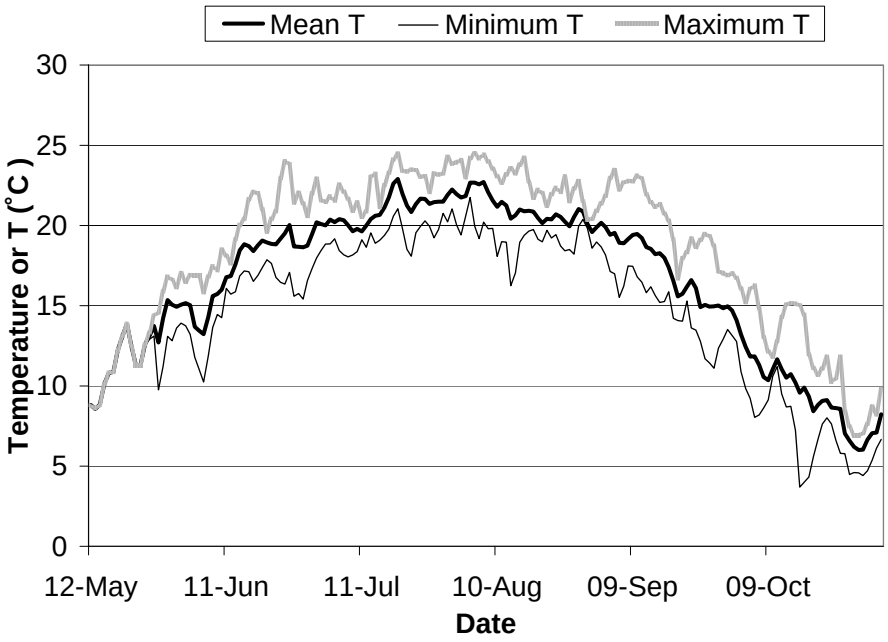

Figure 15: Average daily water temperature in Shemogue NB, from 1996 to 1999 and 2001. Note: The oyster monitoring cage was lost in September 2000.

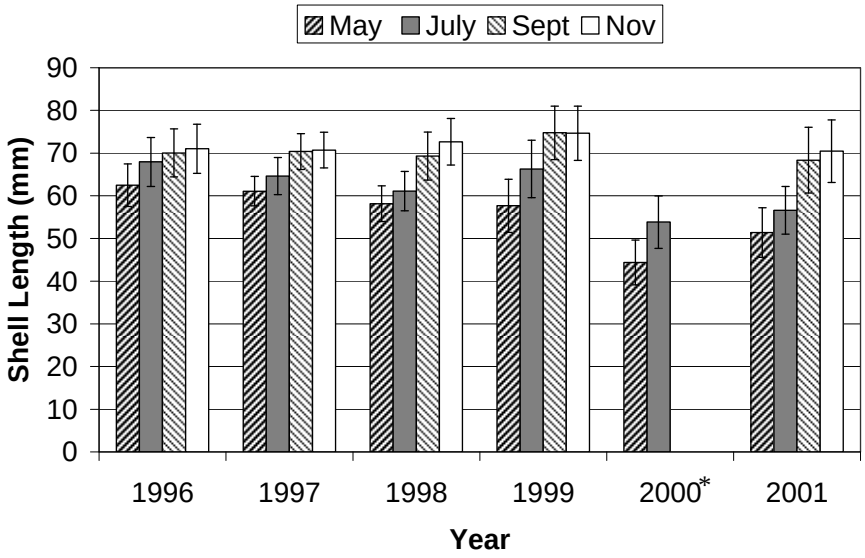

Figure 16: Average shell length monitored in May, July, September and November length in Shemogue NB, from 1996 to 2001. *Note: The oyster monitoring cage was lost in September 2000.

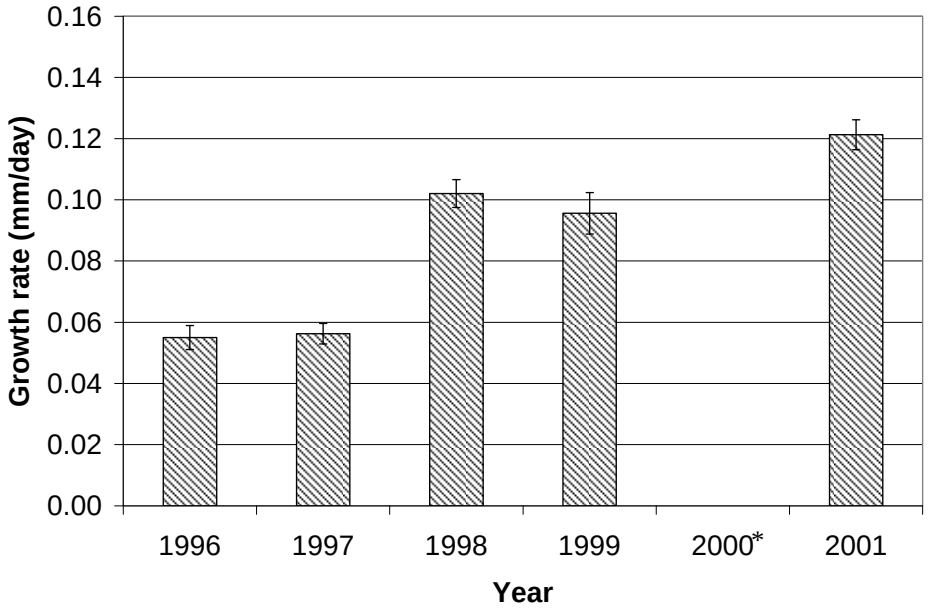

Figure 17: Average shell growth rate from May to November in Shemogue NB, from 1996 to 2001. *Note: The oyster monitoring cage was lost in September 2000.

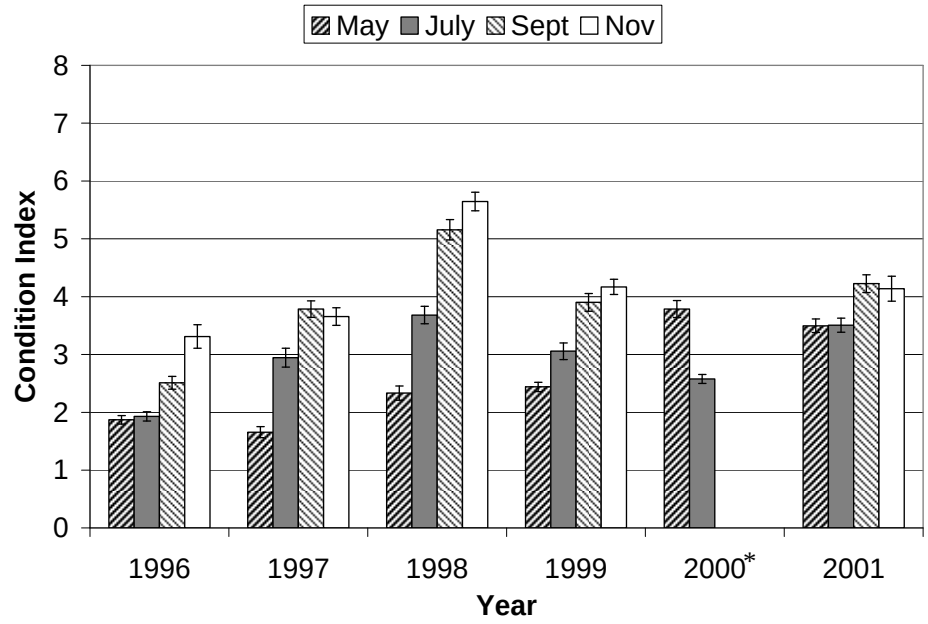

Figure 18: Average oyster condition index from May to November in Shemogue NB, from 1996 to 2001. *Note: The oyster monitoring cage was lost in September 2000.

6.5 Ellerslie (PEI)

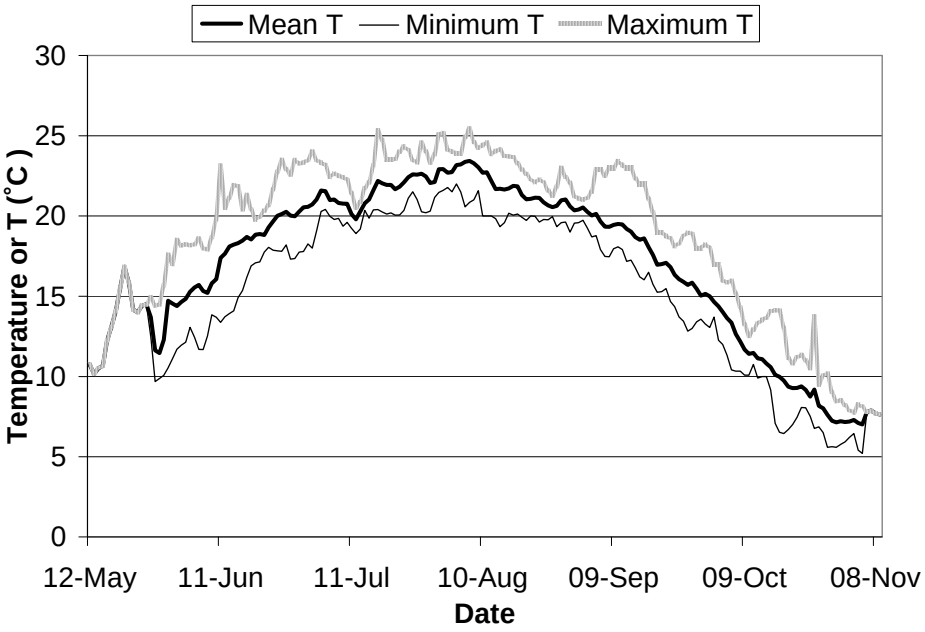

Figure 19: Average daily water temperature in Ellerslie PEI, from 1996 to 2001.

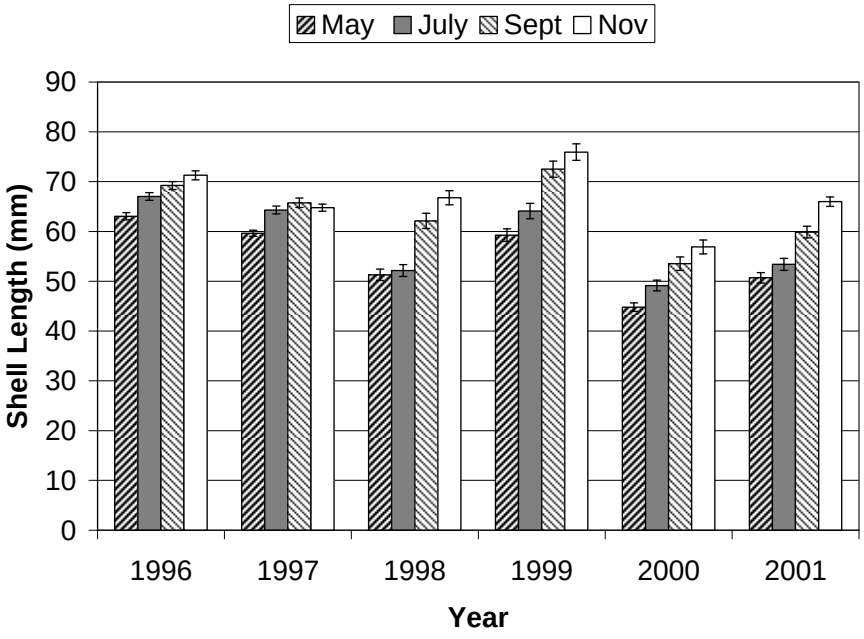

Figure 20: Average shell length monitored in May, July, September and November in Ellerslie PEI, from 1996 to 2001.

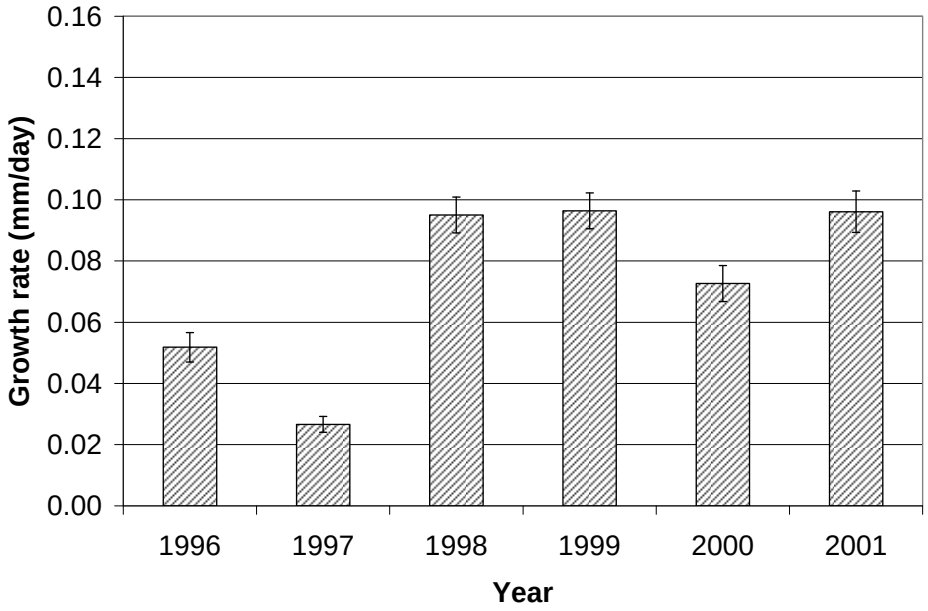

Figure 21: Average shell growth rate from May to November in Ellerslie PEI, from 1996 to 2001.

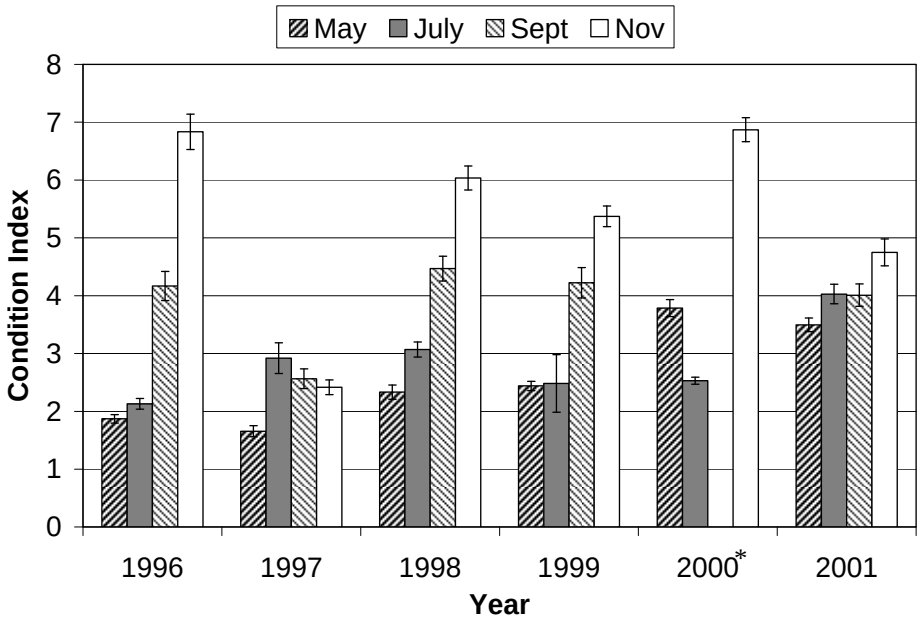

Figure 22: Average oyster condition index from May to November in Ellerslie PEI, from 1996 to 2001. *Note: Samples for condition index were not available for September 2000.

6.6 Tatamagouche (NS)

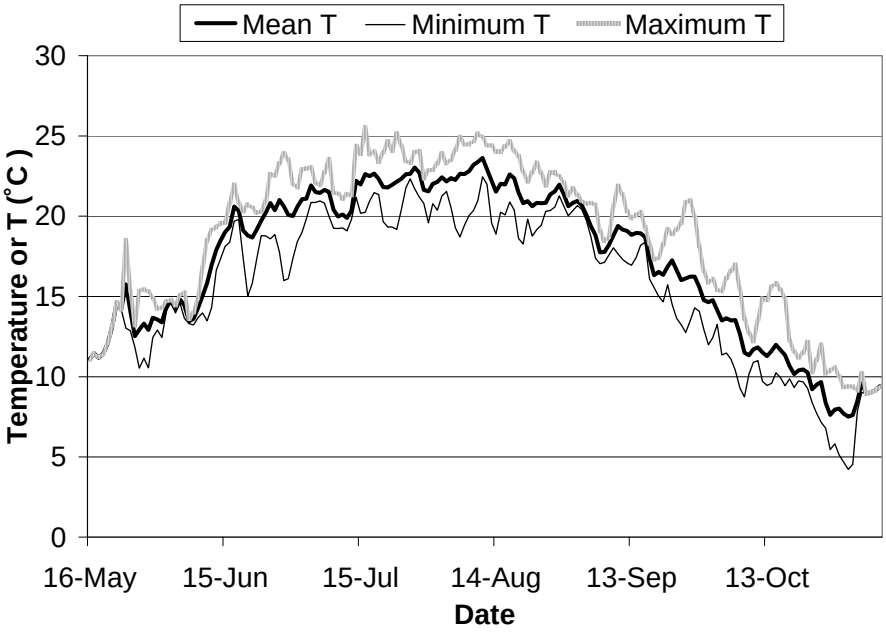

Figure 23: Average daily water temperature in Tatamagouche NS, from 1996 to 2001.

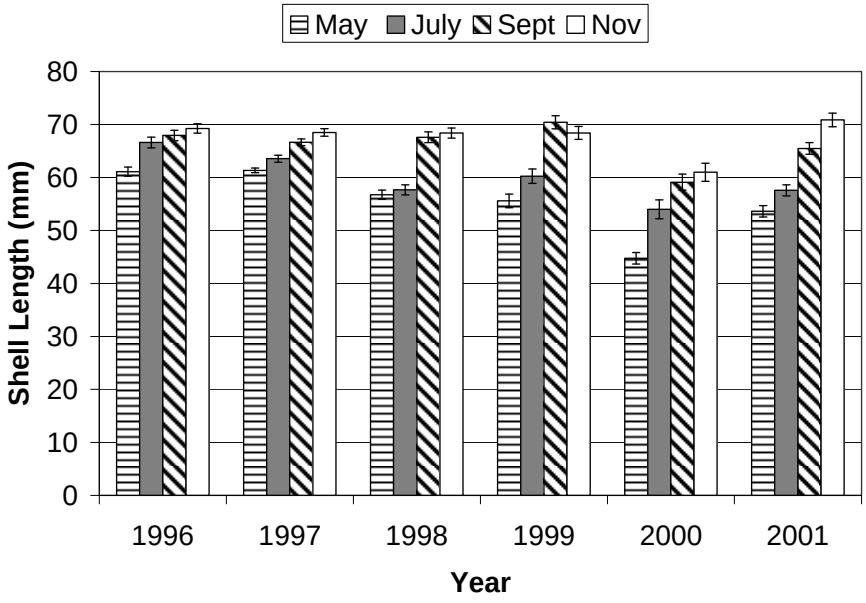

Figure 24: Average shell length in monitored in May, July, September and November in Tatamagouche NS, from 1996 to 2001.

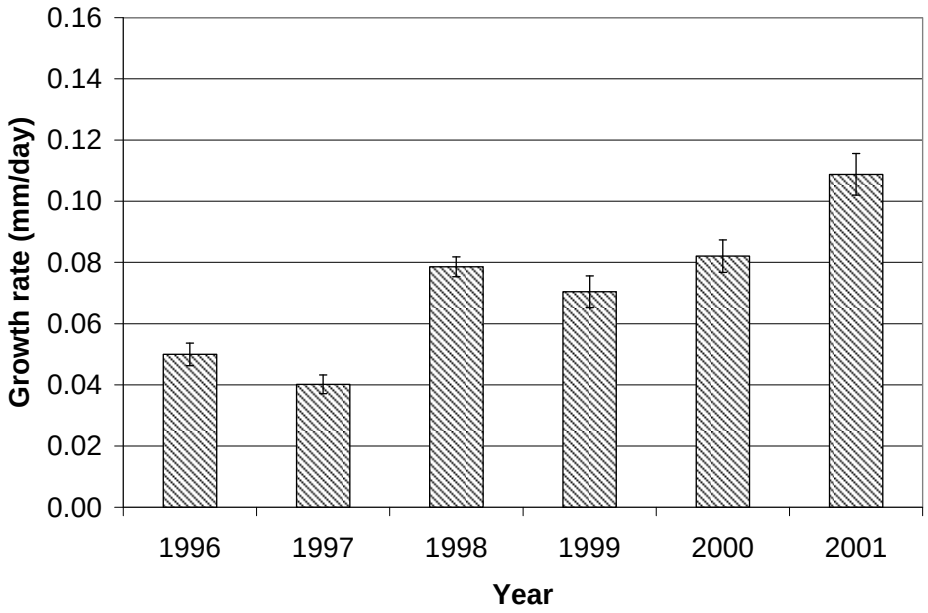

Figure 25: Average shell growth rate from May to November in Tatamagouche NS, from 1996 to 2001

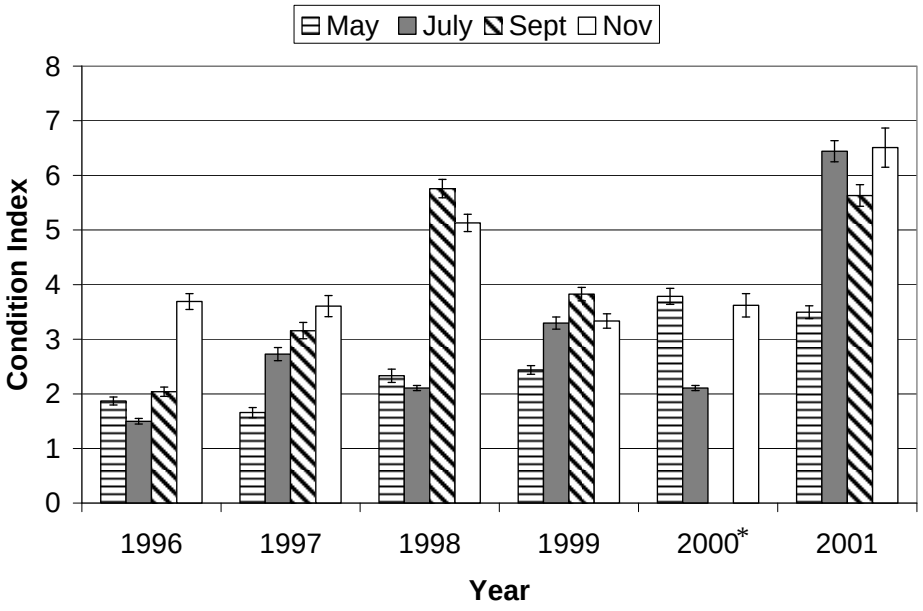

Figure 26: Average oyster condition index from May to November in Tatamagouche, from 1996 to 2001. *Note: Oyster samples for condition index were not available in September 2000.

6.7 St. Mary's Bay (NS)

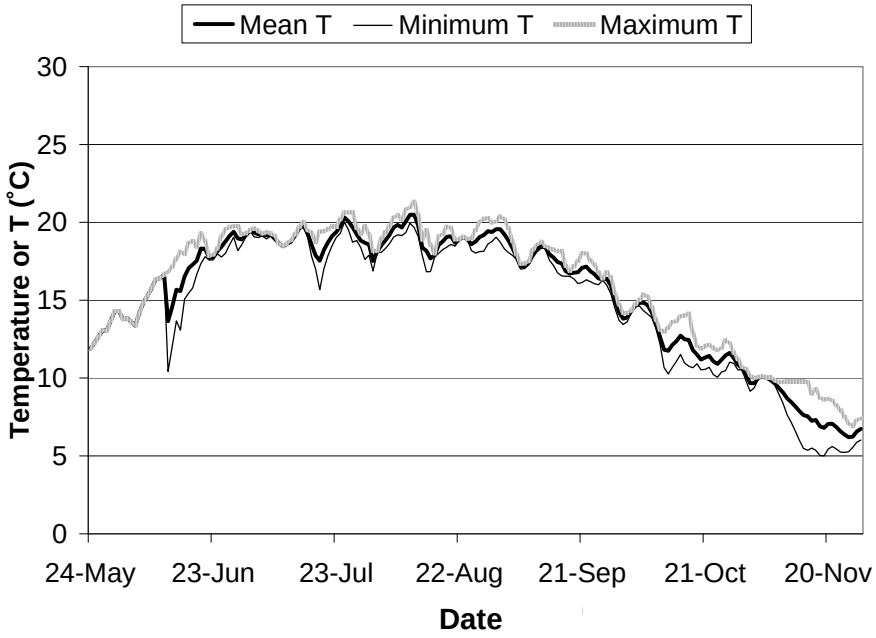

Figure 27: Average daily water temperature in St. May's Bay NS, for 2000 and 2001.

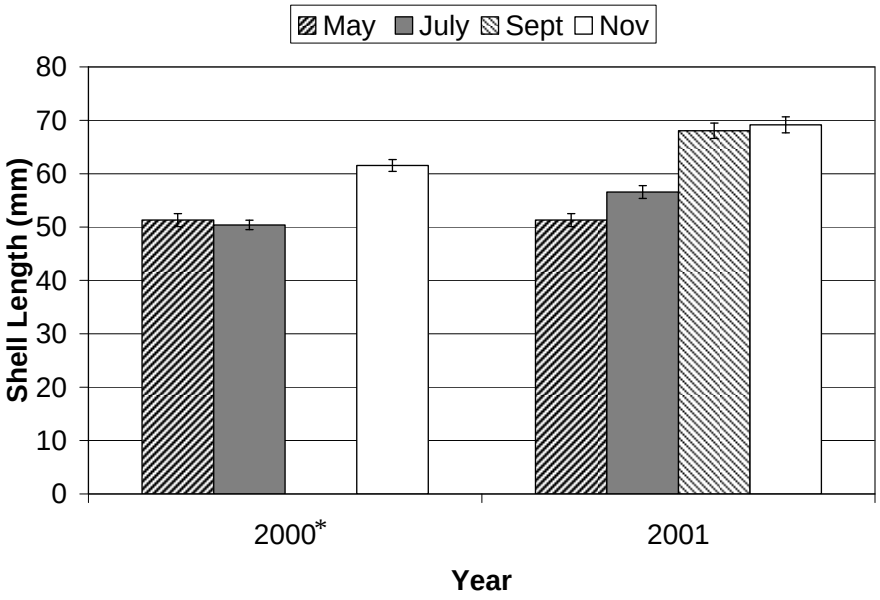

Figure 28: Average shell length monitored in May, July, September and November in St. Mary's Bay NS, for 2000 and 2001. *Note: Oyster lengths were not available in September 2000.

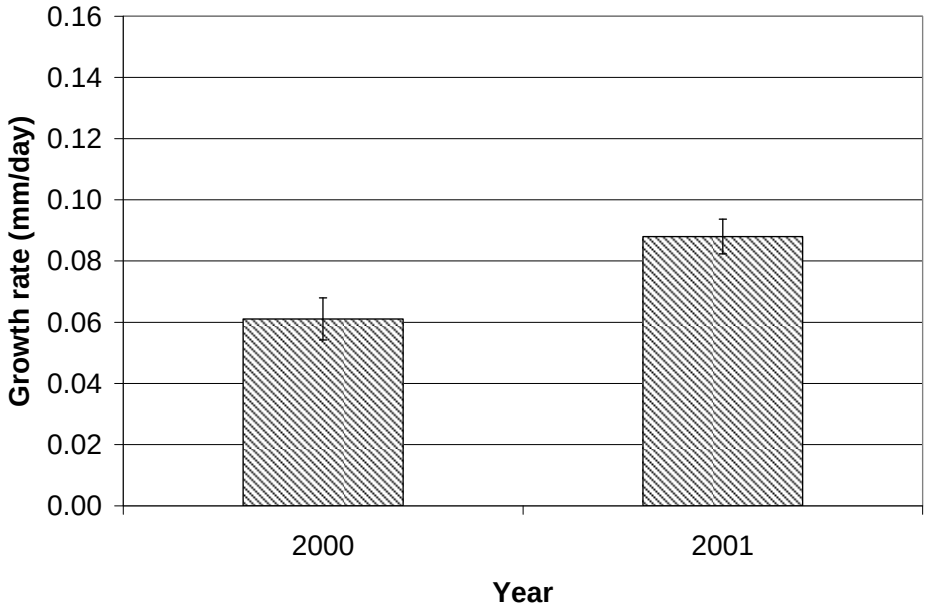

Figure 29: Average shell growth rate from May to November in St. Mary's Bay NS, for 2000 and 2001.

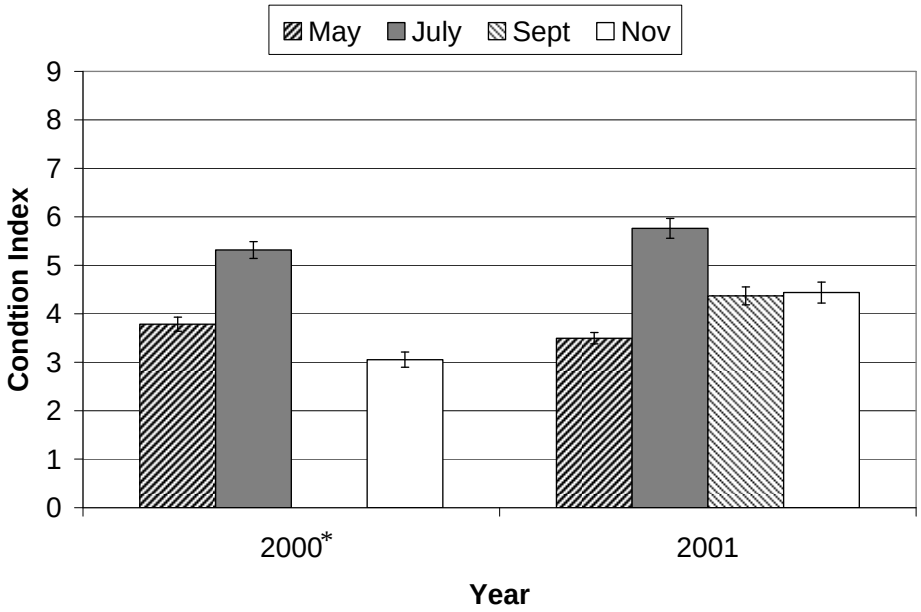

Figure 30: Average oyster condition index from May to November in St. Mary's Bay, for 2000 and 2001. *Note: Oyster samples for condition index were not available in September 2000.

6.8 Wedgeport (NS)

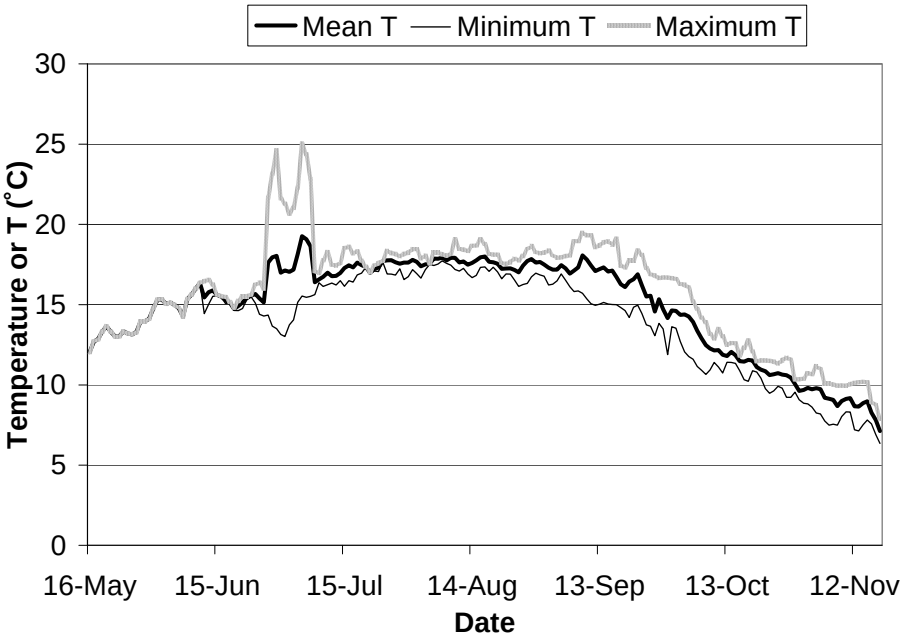

Figure 31: Average daily water temperature in Wedgeport NS, from 1998 to 2000.

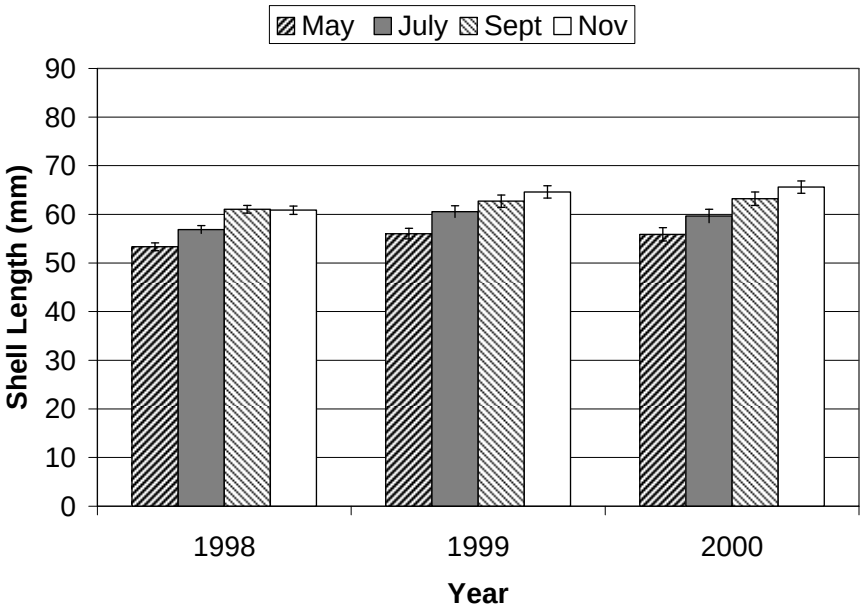

Figure 32: Average shell length monitored in May, July, September and November in Wedgeport NS, from 1998 to 2000.

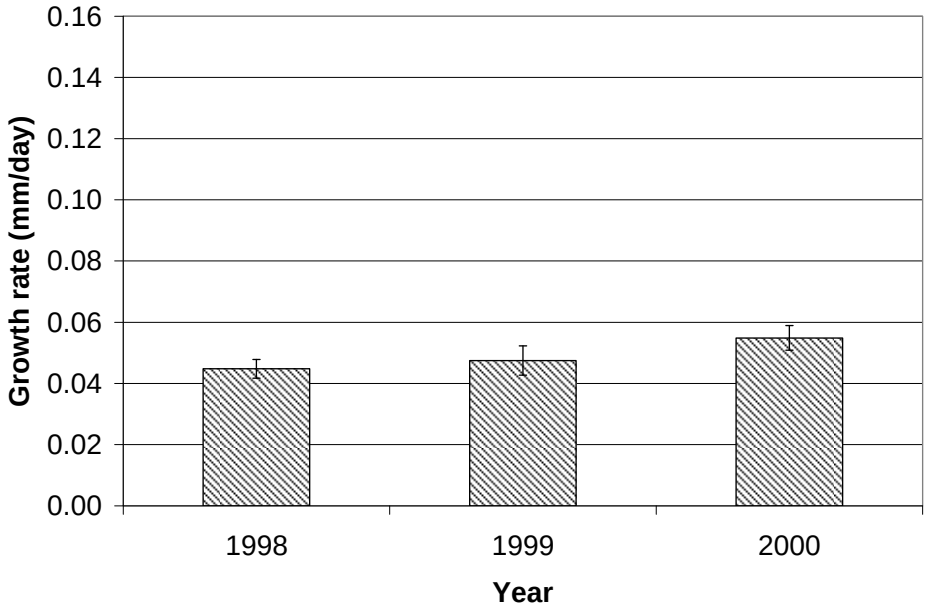

Figure 33: Average shell growth rate from May to November in Wedgeport NS, from 1998 to 2000.

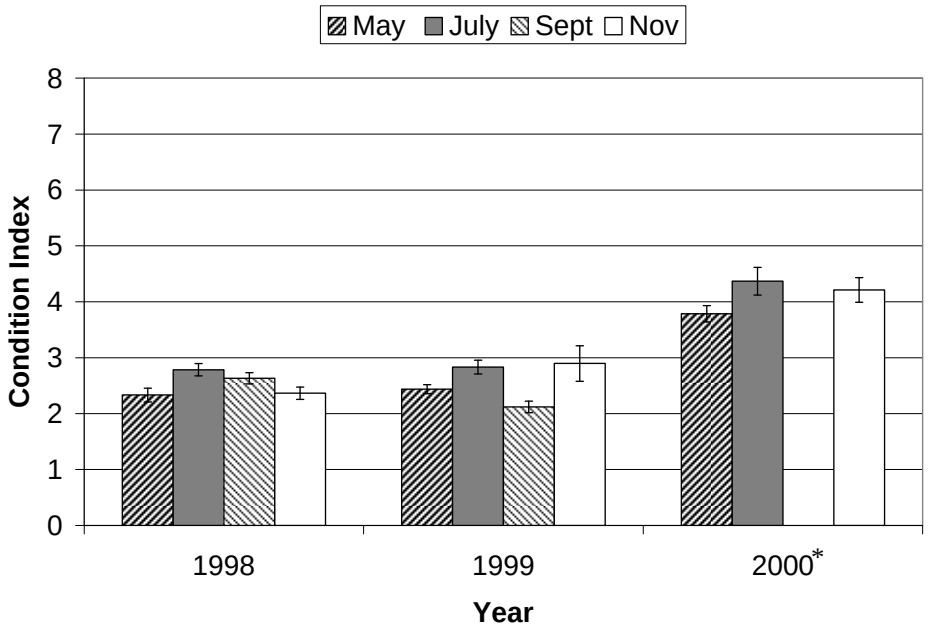

Figure 34: Average oyster condition index from May to November in Wedgeport NS, from 1998 to 2000. *Note: Oyster samples for condition index were not available in September 2000.

6.9 Bassin aux Huîtres (QC)

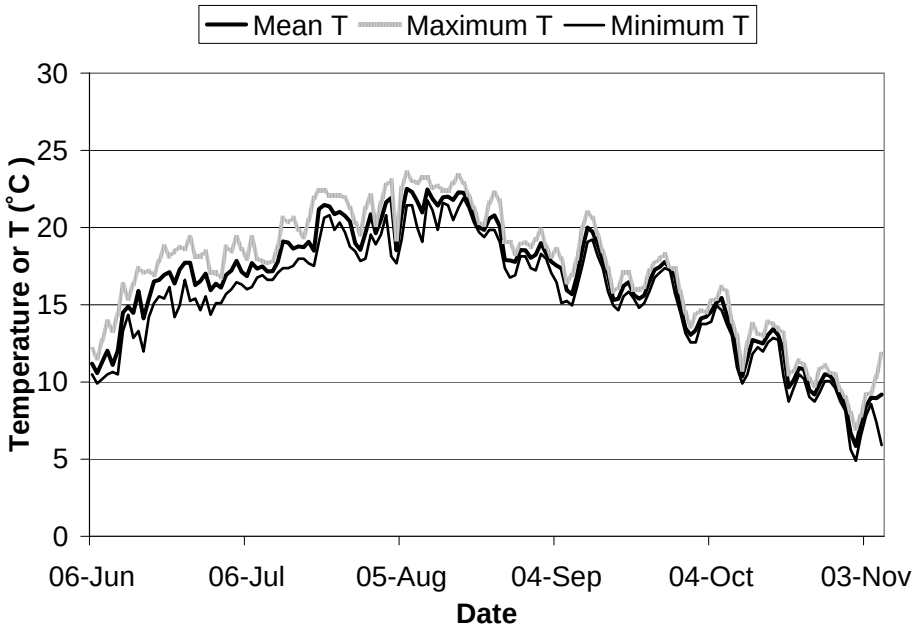

Figure 35: Average daily water temperature in Bassin aux Huîtres QC, for 2000 and 2001.

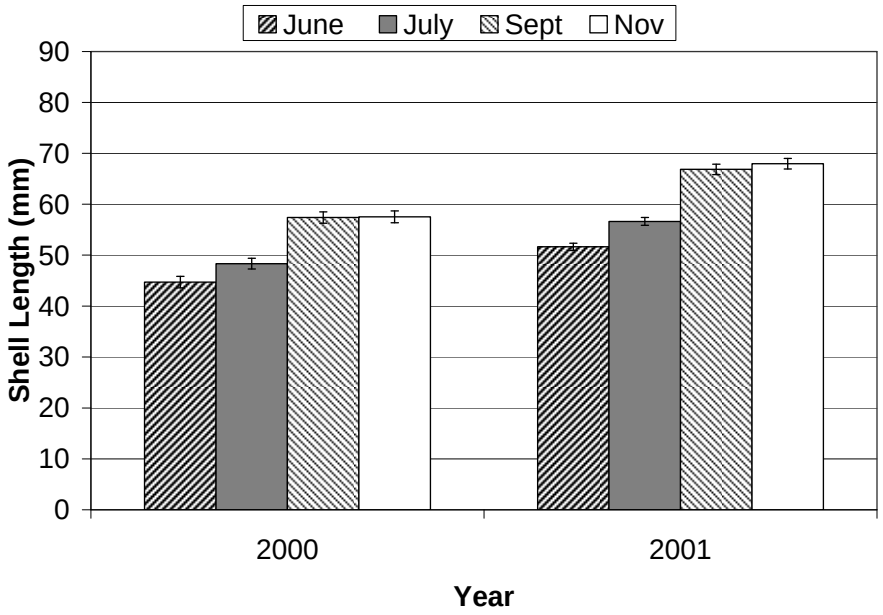

Figure 36: Average shell length growth monitored in May, July, September and November in Bassin aux Huîtres QC, for 2000 and 2001.

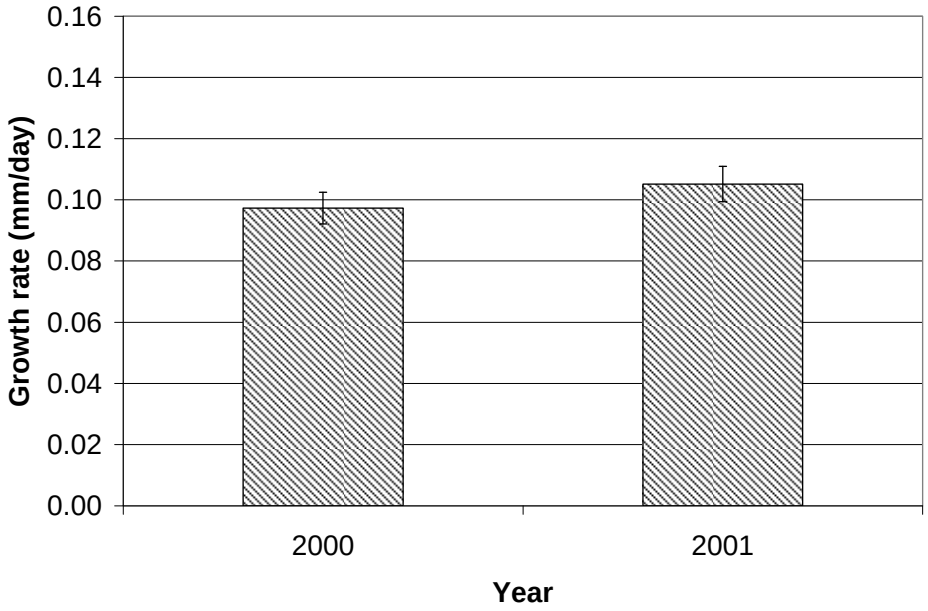

Figure 37: Average shell growth rate from May to November in Bassin aux Huîtres QC, for 2000 and 2001.

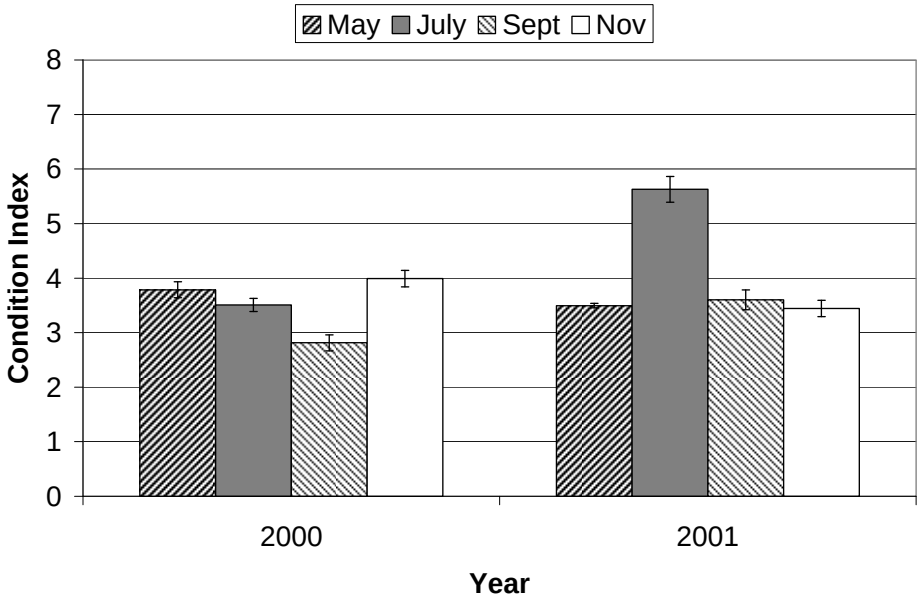

Figure 38: Average oyster condition index from May to November in Bassin aux Huîtres QC, for 2000 and 2001.

6.10 Cap Vert (QC)

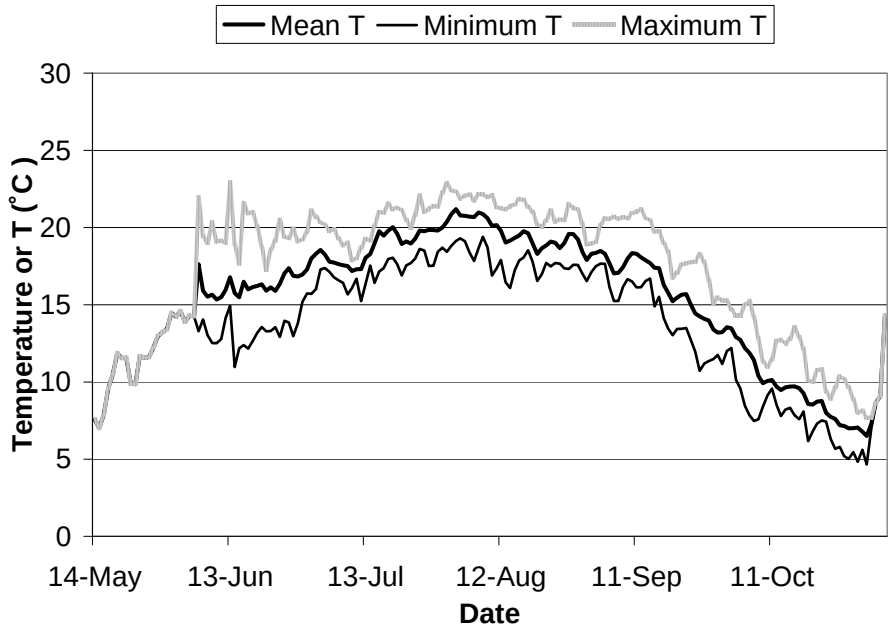

Figure 39: Average daily water temperature in Cap Vert QC, from 1997 to 2001.

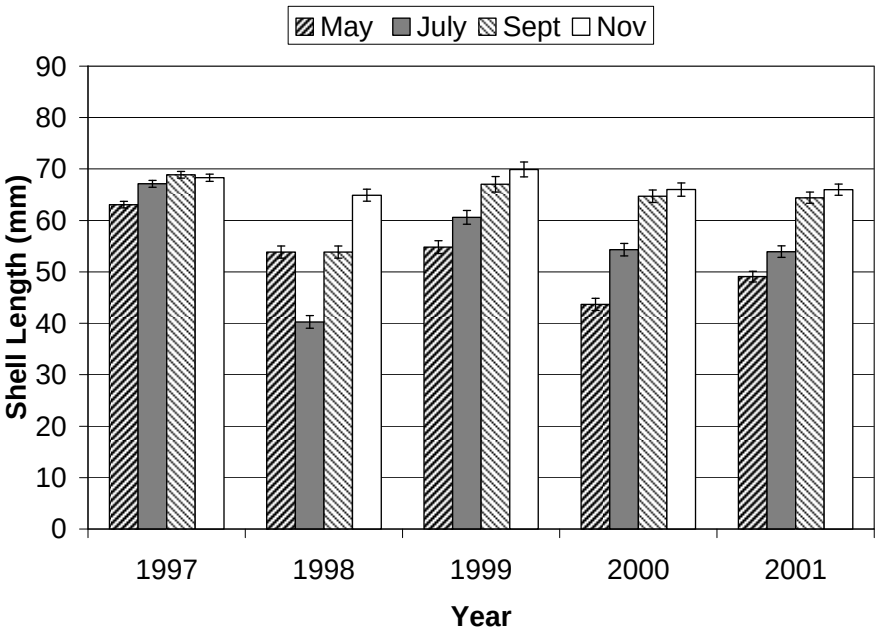

Figure 40: Average shell length monitored in May, July, September and November in Cap Vert QC, from 1997 to 2001.

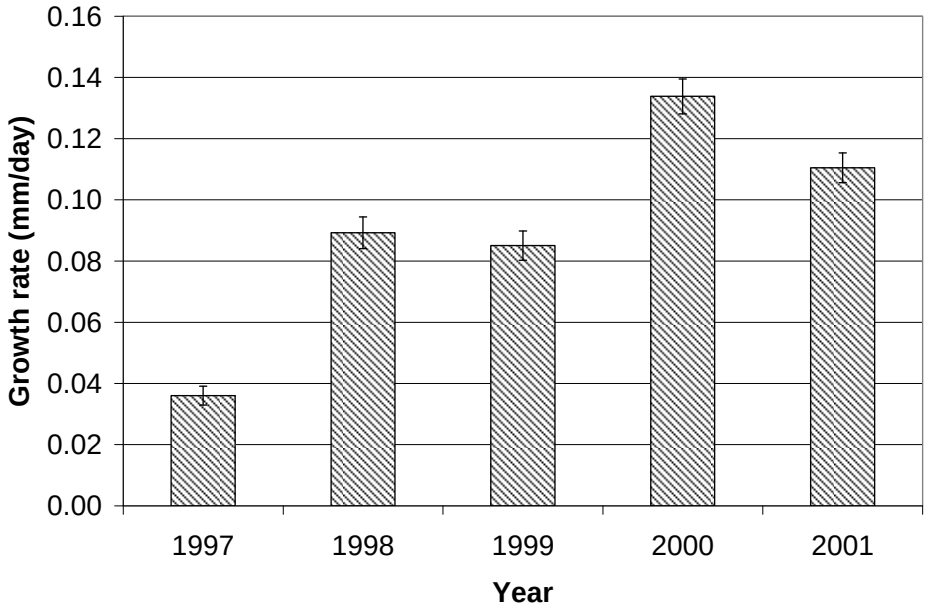

Figure 41: Average shell growth rate from May to November in Cap Vert QC, from 1997 to 2001.

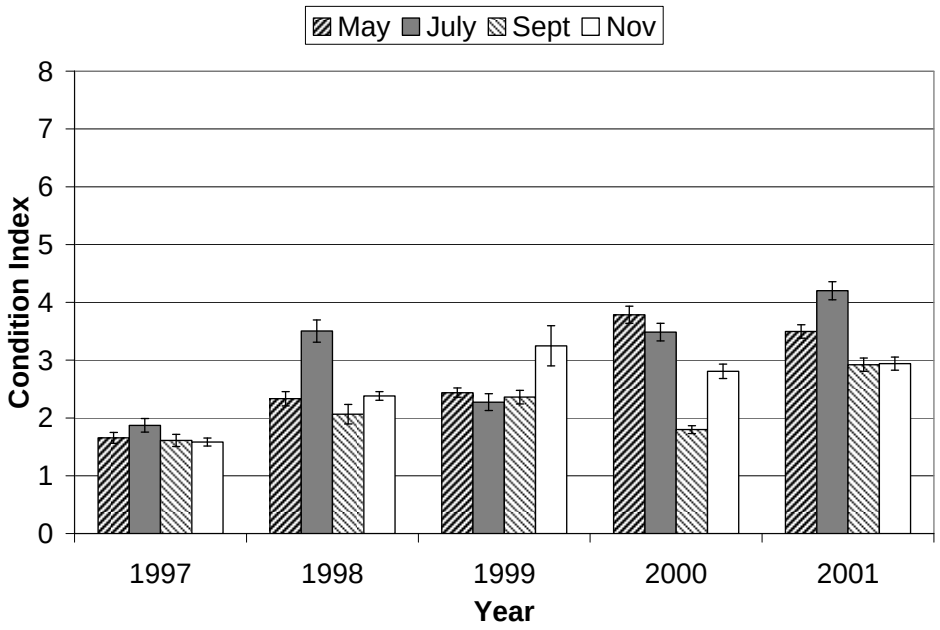

Figure 42: Average oyster condition index from May to November in Cap Vert QC, from 1997 to 2001.