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Variation in Annual Growth in a Newfoundland Population of Lobsters (Homarus americanus) in Relation to Temperature Conditions

by

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ABSTRACT

Over the period 1974 to 1980, accumulated degree-days (above 0°C) from May 1 to July 15 ranged from 42 to 379 on the Comfort Cove, Notre Dame Bay lobster grounds. Proportions molting in both male and female prerecruit and recruit size groups varied substantially from year to year, especially in the recruit size group where proportion molting was consistently lower than in the prerecruit size group. In both size groups males consistently had a higher proportion molting. In the prerecruit size group proportion molting increased with increasing degree-days up to ~250, beyond which it tended to fluctuate. In the recruit size group, except for two anomalously low values, proportion molting continued to increase with increasing degree-days.

RESUME

Le nombre de jours-degrés (au-dessus de 0°C) accumulés entre le 1er mai et le 15 juillet 1974-80 a varié entre 42 et 379 sur les lieux fréquentés par le homard dans l'anse Comfort (baie Notre-Dame). La proportion des homards en voie de mue, tant mâles que femelles, dans les groupes de taille prérecrues, et recrues fluctua grandement d'une année à l'autre. Ce fut le cas surtout chez les recrues où la proportion des sujets en voie de mue fut toujours plus faible que chez les prérecrues. Dans les deux groupes, la proportion en voie de mue fut toujours plus forte chez les mâles. Parmi les prérecrues, la proportion des homards en voie de mue augmenta en fonction du nombre de jours-degrés jusqu'à ~250. Passé ce seuil elle tendit à fluctuer. Dans le groupe des recrues, sauf pour deux valeurs anormalement basses, la proportion en voie de mue continua à augmenter avec le nombre de jours-degrés.

INTRODUCTION

In a fishery such as that for lobsters where the standing stock is very heavily dependent on recruitment, it is clear that annual growth is a key factor in determining the harvestable supply in any year. Annual growth is likely to be strongly influenced by variability in temperature conditions during the period preceding the molting season (Robinson 1979; Aiken 1980), especially in Newfoundland waters where lobsters are near the northern limit of their geographic range. Relevant data from an ongoing study of the lobster fishery and various aspects of lobster population biology at Comfort Cove, Notre Dame Bay on the northeast coast of Newfoundland are analysed and presented.

MATERIALS AND METHODS

A study of lobsters conducted at Comfort Cove, Notre Dame Bay since 1971 has included special fishing in the autumn, following the molting period (i.e. mid to late summer), for the purpose of tagging commercially legal lobsters to obtain estimates of various population parameters based on tag returns during the fishing season (April 20 -July 15) the following spring (Ennis 1981). Starting in 1974 all lobsters caught during the period of special fishing were examined for shell condition to determine whether or not each had molted during the preceding summer molting period (Ennis 1977). Estimates of proportions molting by size were derived from the shell condition sampling as described by Ennis (1978). Mean daily temperatures throughout the fishing season were obtained from thermographs maintained on the bottom near Comfort Cove at a depth of approximately 9 m. Accumulated degree-days (above 0°C) was determined by adding successive mean daily temperatures over the period.

RESULTS AND DISCUSSION

Previous analyses of premolt and postmolt carapace length measurements collected in the same area in two different years have indicated negligible year to year variation in the premolt-postmolt relationship (Ennis 1972, 1978). Consequently, it is the other component of annual growth in a lobster population, i.e. proportion molting, that is more likely to be variable. Estimates of proportions molting were derived for the prerecruit and recruit size ranges (as defined by Ennis et al. (in preparation)) for each sex and these are used here as a basis for determining variability in annual growth.

Robinson (1979) introduced the use of accumulated degree-days as a means of illustrating the importance of temperature conditions to growth rate of lobsters in an area. According to Aiken (1980), at a temperature of 5°C lobsters will progress slowly through the molt stages to D_0 and stop, but will continue slowly through premolt and can complete ecdysis in temperatures as low as 0°C provided molt stage D_1 has been reached before the temperature drops to 5°-6°C. In the Comfort Cove area lobsters are trappable at temperatures below 0°C (Ennis et al., in prep.) and it is assumed that some physiological progress towards molting in late July-August does occur over the 0° to 5°C temperature range that commonly last well into June in this area.

Accumulated degree-days (above 0°C) from May 1 to July 15 ranged from 42 in 1974 to 379 in 1979 (Table 1). Unfortunately the thermographs were usually

not maintained beyond July 15, the last day of the commercial fishing season. Temperature conditions between July 15 and the molting period (which starts around the end of July) will undoubtedly influence the proportion molting in a given year, however, it is felt that temperature conditions during the period May 1 to July 15 exert just as great or possibly even greater influence and can be used as a good indicator of year to year variation in temperature conditions over the period that temperature is a factor in determining proportion molting.

Proportions molting in both male and female prerecruit and recruit size groups varied substantially from year to year, especially in the recruit size group where proportion molting was consistently lower than in the prerecruit size group (Table 1). In both size groups males consistently had a higher proportion molting.

In the prerecruit size group proportion molting increased with increasing degree-days up to ~ 250 (Fig. 1), beyond which it tended to fluctuate, suggesting that beyond a certain level, factors other than temperature become more important than they are at lower temperature levels. In the recruit size group, except for anomalously low values for males in 1978 and for females in 1977, proportion molting continued to increase with increasing degree-days.

It is clear from these data that in Newfoundland waters, temperature conditions during the period preceding the molting season vary substantially from year to year and result in variation in proportions molting and hence annual growth within the lobster population. Estimates indicate that as much as 90% by number of the standing stock in any one fishing season is from recruitment through growth since the preceding fishing season (Ennis 1981). Under such conditions, substantial fluctuations in the supply of harvestable lobsters will occur as a result of year to year variation in temperature conditions preceding the molting season. These fluctuations could be reduced by lowering exploitation rates, thereby reducing the impact of variations in recruitment on the fishery.

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Table 1. Accumulated degree-days (above 0°C during May 1 to July 15) and proportions molting in the prerecruit and recruit size ranges at Comfort Cove, 1974-80.

Year	Accumulated degree-days	Prerecruit size range		Recruit size range	
		Males	Females	Males	Females
1974	42.1	75.5	64.2	41.8	22.2
1975	247.7	93.0	88.1	73.0	50.0
1976	339.5	90.4	76.1	90.3	63.2
1977	308.2	95.0	83.3	78.8	36.0
1978	306.2	85.0	77.2	44.2	73.1
1979	379.1	93.2	81.7	85.7	64.3
1980	176.2	86.6	80.9	67.5	45.0

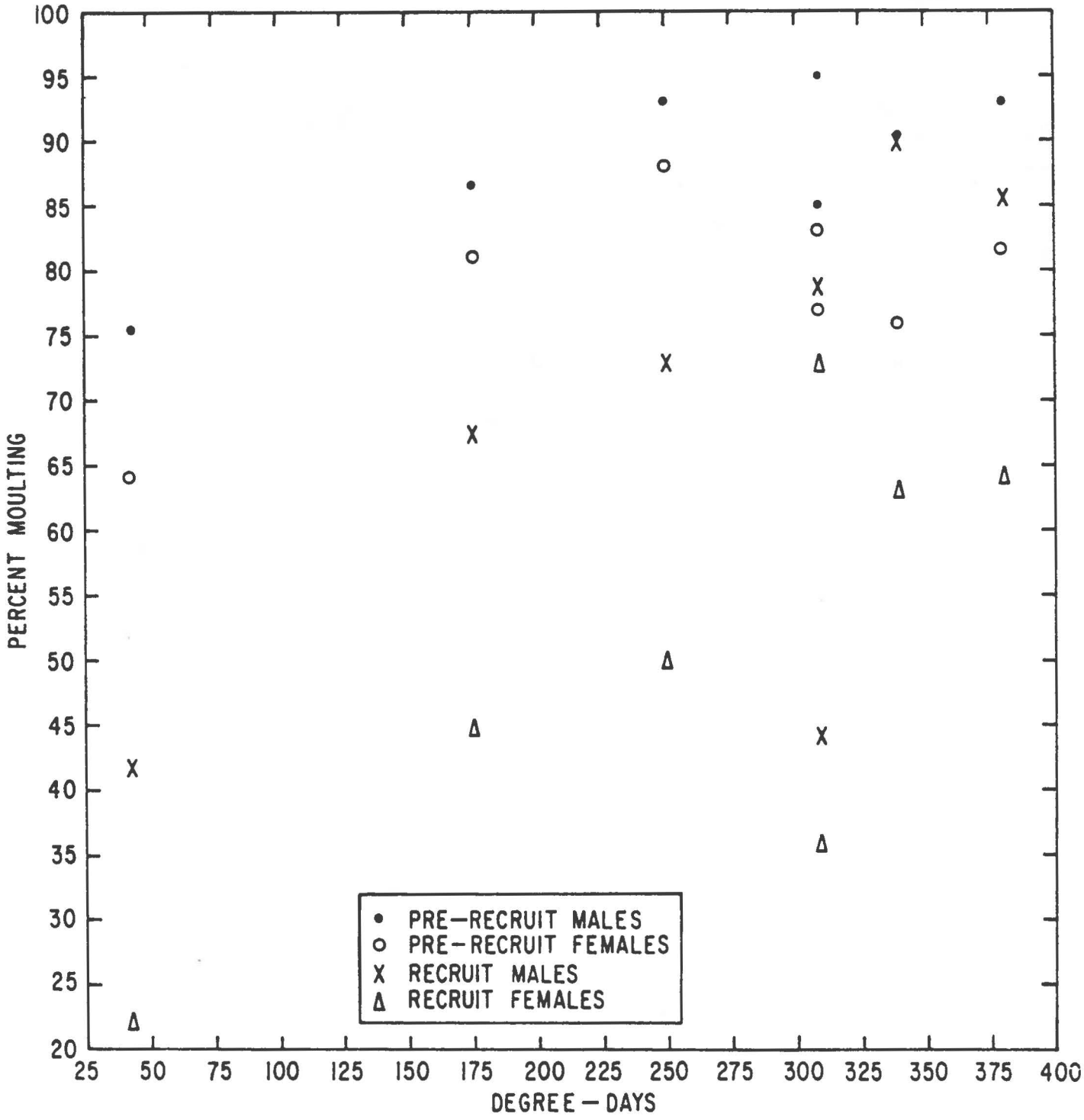

Fig. 1. Annual proportions molting in Comfort Cove lobsters in relation to accumulated degree - days (above 0°C) over the period May 1 to July 15.