

Figure 2 Chart shows the variation in blood protein levels between a deep area (Yarmouth Bar Outside) (red line) and shallow area (Argyle Inside) (blue line) of LFA 34, 2004-2006.

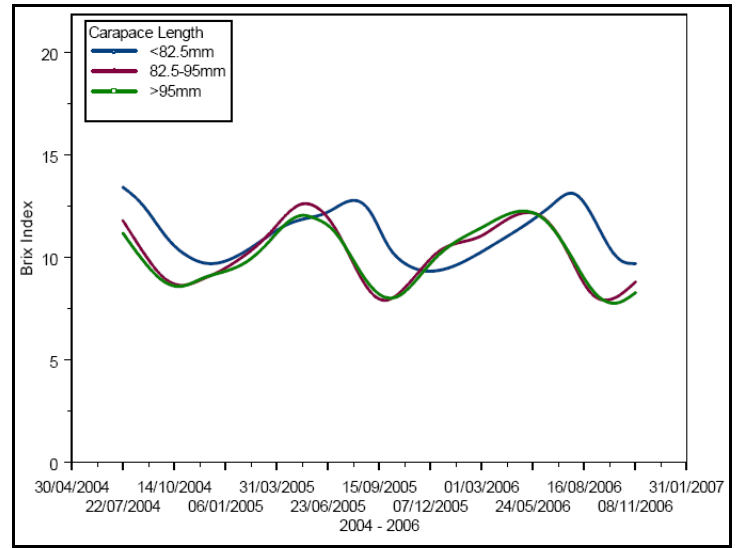


Figure 4 Blood protein levels for three carapace length classes, 2004-2006.

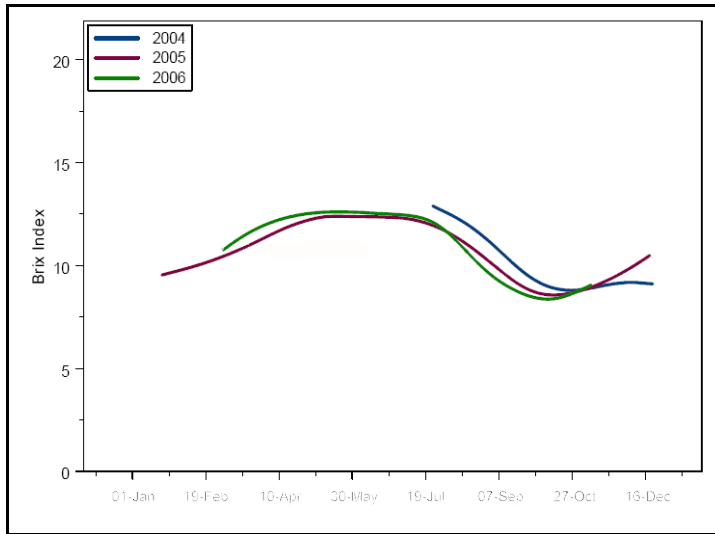


Figure 3 Annual blood protein-level variation between 2004 and 2006.

Temperature data came primarily from the FSRs recruitment trap program, supplemented by opportunistic sampling associated with other surveys and the coastal temperature data base. Only data at consistent depths and locations were used. Temperature also was likely relevant in the significant differences in blood protein between years (Figure 3). The 2004 moult occurred approximately 20 days later than in 2005 and 2006. Temperature profiles (calculated using a method similar to a running average smoothing technique [loess method]), indicate an advanced warming trend in the spring temperatures in 2005 and 2006 over 2004. However, it is unknown whether this trend continued as no water temperature profile for the summer of 2006 is yet available.

The study also provided information about moulting behaviour in relation to lobster size. The relatively small reduction in

blood protein levels during the fall moult indicates that fewer of the small lobsters (less than 82.5 mm carapace length [cl]) are moulting at the same time, and the smaller lobsters are moulting later than the two larger classes studied (Figure 4). These differences are more likely related to life history than temperature differences, because each group was subjected to the same environmental temperatures. That larger lobsters moult first does not match fishermen's expectations and experience and is surprising to them. Additional analysis of the data will be required to explain this result. The fishermen on our committee suggested that analysis by area and moult stage might help with the interpretation of these results. This idea will be examined in the next step of the analysis.

The two larger carapace classes exhibited a similar moulting pattern. Both groups of lobsters that were >82.5 mm included immature and mature lobsters because, for this geographic area, 50% of lobsters are mature at 95 mm cl. The similarity in moulting patterns within these groups indicates that moult timing is not related to sexual maturity; otherwise, a difference within the two larger size groups would be observed. A number of hypotheses related to life history characteristics need to be investigated to explain these results.

The study also investigated blood protein according to the sex of the lobster. Although differences between males and females were less distinct than those associated with depth, they are statistically significant. To interpret these biological differences will require further exploration.

CONCLUSIONS

Lobsters in deeper waters have a delayed moult cycle relative to shallow-water lobsters with water temperature having a significant influence on this relationship. Between-year differences in blood protein levels are significant: it appears that water warmed more quickly in the springs of 2005 and 2006 than in 2004, resulting in a relatively early moult in those years. Carapace length classes differ in their moult timing as well. Small (<82.5mm cl) lobsters moult later and are less inclined to moult in unison than large lobsters. No obvious influence of maturity state on blood protein levels was observed in lobster larger than 82.5 mm. The sexes differ in their moulting pattern throughout the year, but that is far less pronounced than differences observed between deep and shallow areas. Although other factors regulate moult timing in lobsters, water temperature appears to be the most important.

Monitoring needs to continue in order to understand if the changes are part of a developing trend or a unique occurrence. The continued lobster monitoring will be accompanied by analyzing trends in moult stage, in combination with blood protein, and improved temperature monitoring to better understand and predict low quality years. Future work, depending on funding, would include laboratory experiments to test ideas identified during the field monitoring.

Data from this project is kept up to date on the AVC Lobster Science Centre web site: (<http://www.lobsterscience.ca/molt/>).

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Figure 5 Sampling lobster blood protein occurs at sea using lobster fishing boats: from left are: Cheryl Frail, sampling blood protein; Ross Claytor, measuring; and Ron Duggan, tagging lobsters.

This article was adapted from:

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