Can We Calibrate Pot CPUE with Leslie Analyses?

by

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Abstract

A Leslie depletion study provides estimates of initial stock abundance and initial catch rate. If the relationship between these variables is consistent from year to year, then an estimate of mean catch rate at the beginning of the fishing season can be used to estimate the standing stock. Preliminary examination of data from six areas of Newfoundland suggest this approach may be feasible for obtaining rough estimates of population abundance.

Résumé

Une étude de déplétion de Leslie fournit une estimation de l'abondance initiale du stock et du taux de prises initial. Si le rapport entre ces variables est stable d'année en année, on peut utiliser une estimation du taux de prises moyen au début de la saison de pêche pour apprécier le stock actuel. L'examen préliminaire de données en provenance de six régions de Terre-Neuve permet de croire cette méthode nous fournirait des estimations approximatives de l'abondance de population.

Under suitable conditions, catch per unit of effort (cpue) is a useful index of population size. In theory, such an index can be calibrated, by comparing index values to corresponding estimates of absolute population size, to obtain an estimate of absolute population. For snow crab assessment work, there are a number of estimates of absolute population size available from Leslie analyses. If we could determine that there is a strong relationship between cpue at the beginning of the season and the Leslie population estimates, then preseason pot surveys or commercial catch-effort sampling at the beginning of the season could be used to obtain useful population estimates for setting - or checking - catch quotas. Fletcher et al. (1990) applied this technique to coconut crab (*Birgus latro*) populations in Vanuatu. Conversely, if there isn't a strong relationship between initial cpues and population estimates, then the question "Why? becomes important.

Materials and Methods

We examined all of the Leslie analyses of Newfoundland snow crab stocks described in the CAFSAC Research Document series. For each of the stocks, we plotted population estimates (y-axis intercepts) versus the corresponding initial cpues (x-axis intercepts). Each plot contained between 4 and 7 points.

This approach will not be very useful if one must accumulate results for a large number of years for each stock. For this reason, it is of interest to see if one can combine data from several stocks to define a generally applicable relationship. In theory, this can be accomplished by plotting population density against initial cpue, where density is estimated as the Leslie population estimate divided by the area inhabited by the stock.

Results and Discussion

Depending on the stock, the relationship between intial cpue and Leslie population estimate is poor ($r^2 = 0.05$) to good ($r^2 = 0.97$), as shown in Figure 1.

When all of the data are combined (Figure 2), the result is a definite, though noisy, relationship. The two high points to the left of the figure are extremely influential, causing the ordinary least squares regression line to be extremely flat and causing the residuals to have a distinct pattern. For this reason, we fitted a straight line using a robust regression technique, least median of squares regression (see Rousseeuw 1984). The resulting robust r^2 was 0.62. The fitted line is predicted density = - 1.26 + 0.20 cpue .

It should be noted that the initial cpues in the above analyses were from the commercial fishery. These may not be equivalent to research vessel cpues based on randomized survey designs. For example, the commercial cpues may be higher than the research cpues due to the fishermen selecting high-yield areas. Therefore, if preseason research vessel cpue is to be used to estimate population size, this index should be calibrated separately. Unfortunately, we do not have data on hand to do this.

Literature Cited

Fletcher, W.J., I.W. Brown and D.R. Fielder. 1990. The use of standard and inverse Leslie experiments to estimate the abundance of the coconut crab (*Birgus latro* L.) in Vanuatu. Fisheries Res. 9:317-324.

Rousseeuw, P.J. 1984. Least median of squares regression. J. Am. Stat. Assoc. 79:871-888.

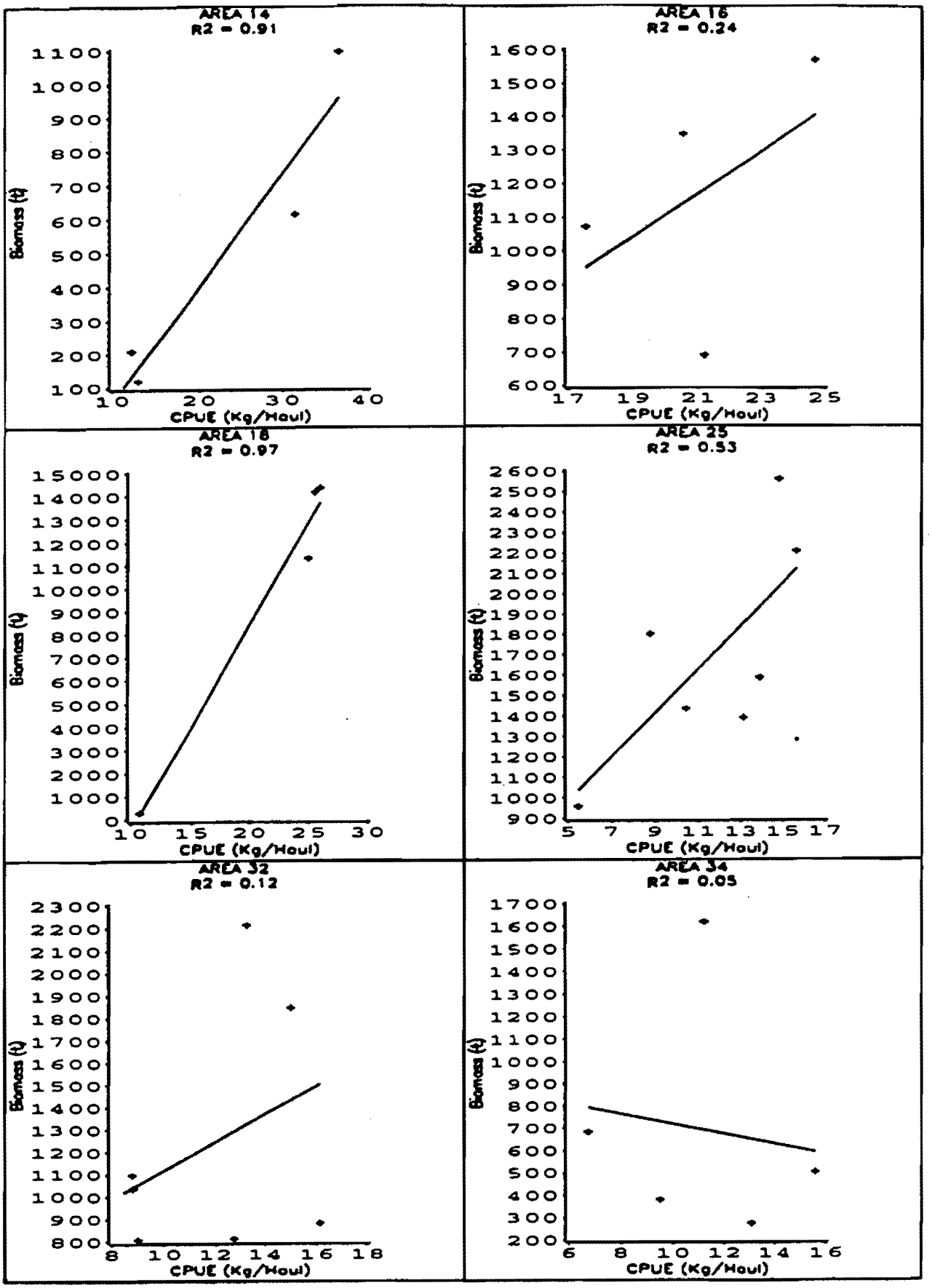

Fig. 1. Regression of initial fishable snow crab biomass on initial catch per unit effort (from Leslie analysis) by Newfoundland stock area.

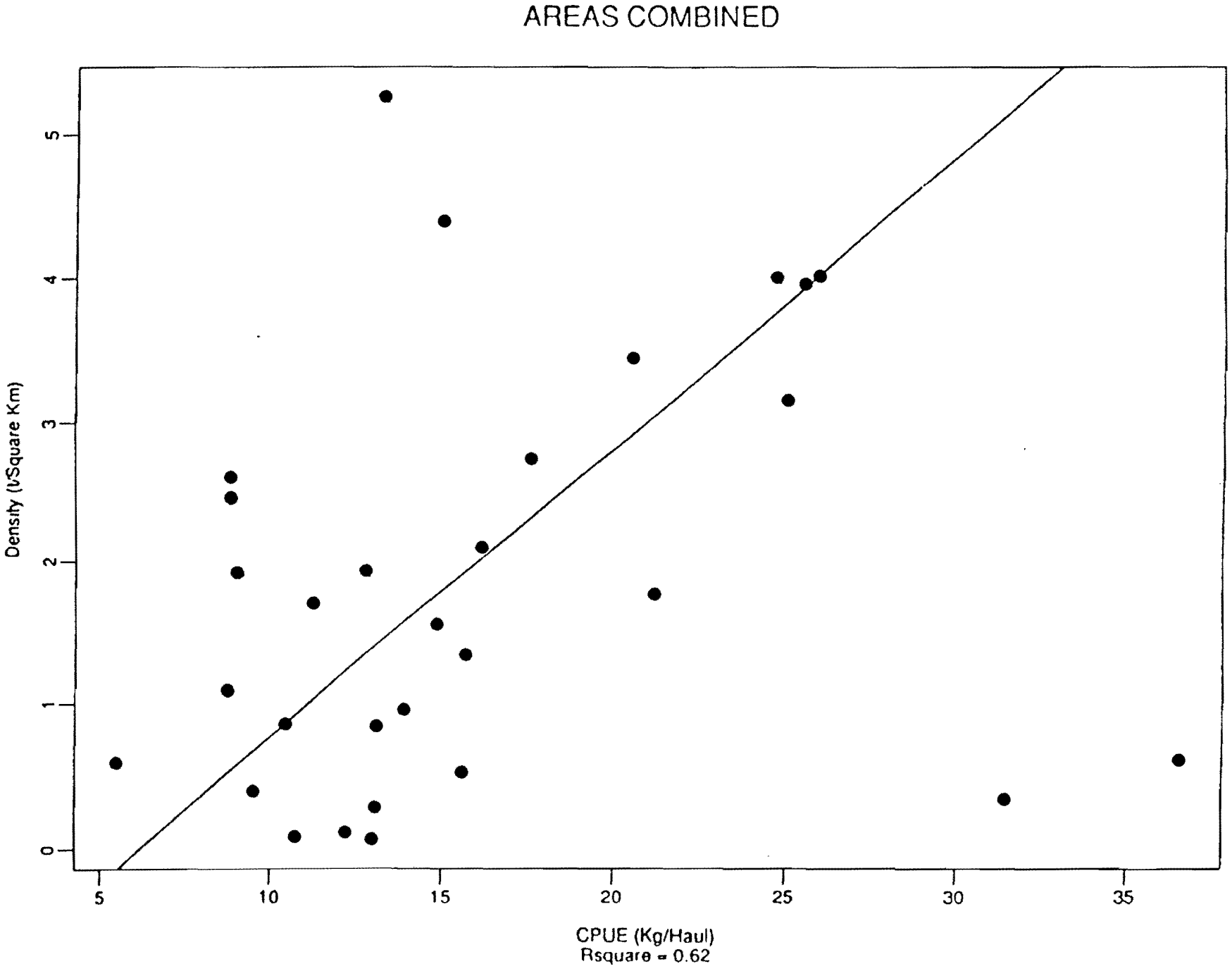

Fig. 2. Regression of initial density of commercial snow crabs on initial catch per unit effort for data pooled over six Newfoundland stock areas.