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An Analysis of Otter Trawl Catch Per Unit Effort for Greenland Halibut

by

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Introduction

The otter trawl catch per effort has been analyzed using multiplicative models in the past NAFO assessments. The multiplicative model has included the following factors: year, month, NAFO Subdivision (e.g. 2J, 3K), and a combined code for country - gear class (e.g. Canadian class 4 otter trawlers). This year, we will examine some of the assumptions of the models. In particular, we were concerned with the following assumptions: (1) the variance of the residuals is constant and (2) there are no important interactions among the components of the multiplicative model.

The assumption of constant variance in the residuals may be seriously wrong in the way the multiplicative model has traditionally been used. The analyses have generally used summaries by year, month, gear, etc., because the raw data has not been available. This has the unfortunate problem of giving equal weight to the monthly summaries. Hutching and Myers (1994) identified this as a problem with some previous assessments because the approach can obscure clear patterns from fishing fleets that have remained stable by giving equal weight to those that come and go from the fishery.

The assumption of no interactions among factors in the multiplicative model is more difficult to deal with. First, it is difficult to know when an interaction is important enough to be included in the model. It may be statistically significant; yet explain very little of the variance. Second, if an interaction includes the year effect, there is no accepted method for then using the results of the resulting analyses, e.g. the ICES methods working group has not decided on a standard method for dealing with the problem.

We will use three approaches to examine these problems. First, we will repeat previous multiplicative models, but instead of giving equal weight to all series, we will weight the log CPUE by the effort for the monthly summary for that gear, country and location. Second, we will examine each of the country/tonnage class CPUE series individually to determine if the overall trend is apparent in each of the individual time series. Third, we will determine if the overall CPUE trend from the multiplicative model remains if we delete the data on each country/tonnage class one at time.

Except for changes that we will discuss, we followed the same procedures as previous assessments as closely as possible. We only considered year/month/NAFO Div./country-gear-tonnage strata which had a minimum of 10 tonnes of catch or 10 hours of effort and appeared in the database at least 5 times. We will only include otter trawl data so that "gear" will refer to tonnage class.

Results

We begin with the analysis of the unweighed multiplicative results (Fig. 1). The longest series (Newfoundland class 5 vessels, 3125) show the same pattern as the overall trend including all the data. Perhaps more importantly, the overall pattern is the virtually the same if these vessels are excluded from the analysis.

The same pattern is seen in all the longer time series considered: Polish class 7 vessels,= (16127), former DDR class 7 vessels (11127), Canadian Maritime class 5 vessels (27125), and Japanese class 6 vessels (14126).

We next repeated the analysis exactly as before except we weighted each cell by the effort. The rational for this is that if we had access to the raw data, we would treat each tow as an individual observation, and carry out a simple unweighed analysis. Since we do not have the raw tow-by-tow data, we weight by the effort, which should be proportional to the number of observations.

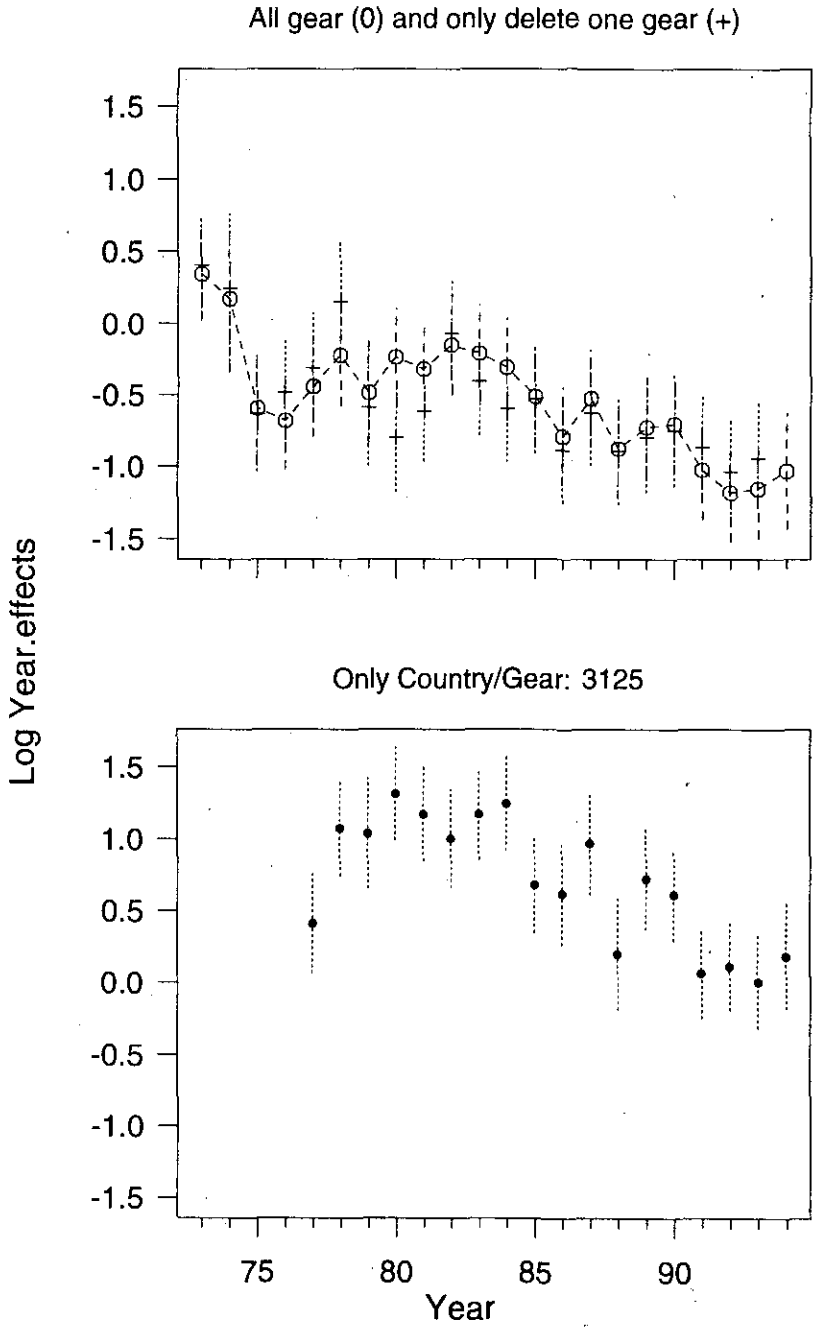
The analysis for the weighted multiplicative results (Fig. 2) gave very similar results as the unweighed analysis. The longest series (Newfoundland class 5 vessels, 3125) shows the same pattern as the overall trend including all the data in the weighted and unweighed analysis. Similar results were obtained from the other country/gear types.

Conclusions

We conclude that the decline in CPUE in the otter trawl data are seen in all the longer time series. The results do not appear to be an artifact of how the multiplicative analysis was carried out, or by interactions associated with different countries or gear types used in the analysis.

As with all analysis of CPUE data from commercial mobil gear the decline in abundance is almost certainly greater than seen in the CPUE data (Hilborn and Walters 1993, Hutchings and Myers 1994)

Country/Gear Deleted or Included: 3125



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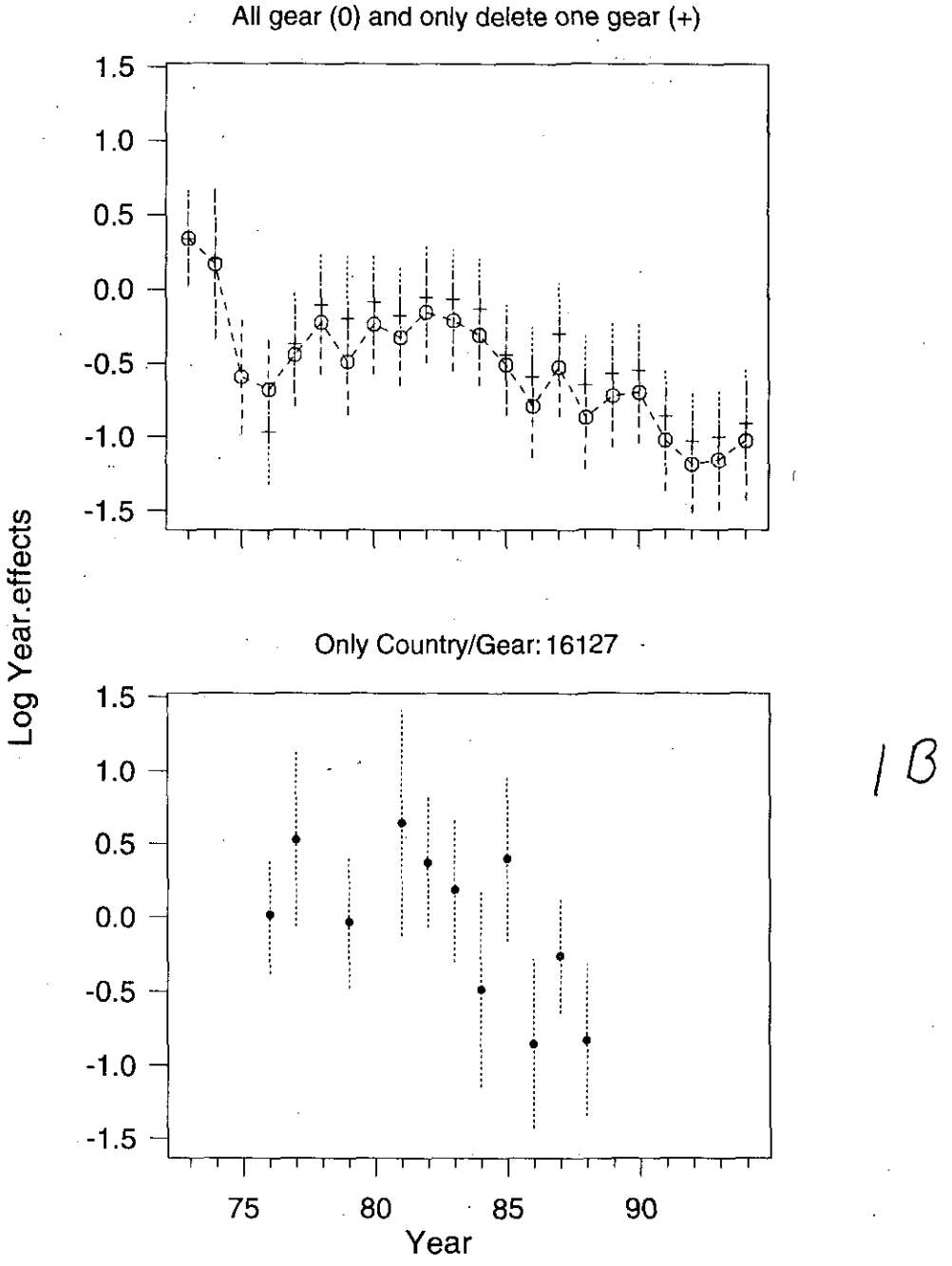
- fig - $\int_{CA}$

1A

Country/Gear Deleted or Included:16127



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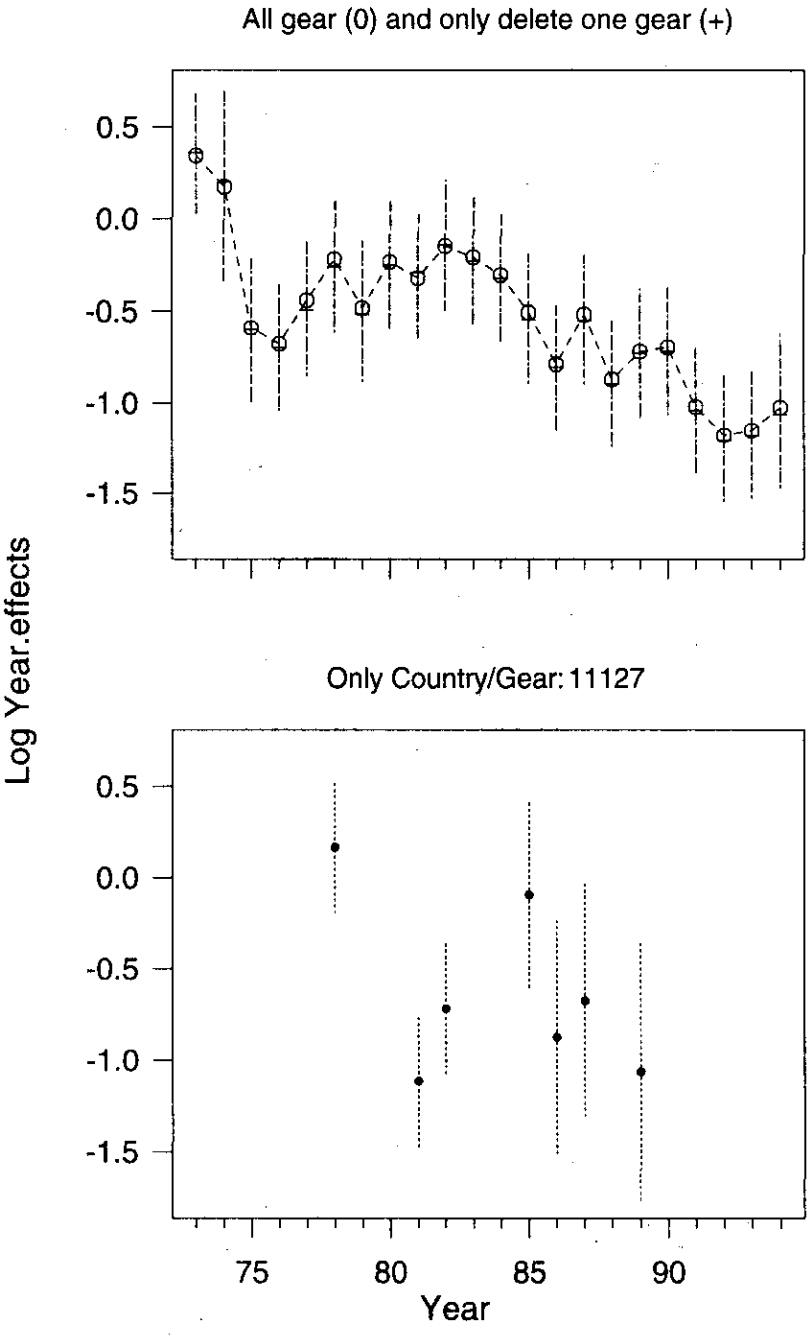
- fig - 16

1B

Country/Gear Deleted or Included:11127



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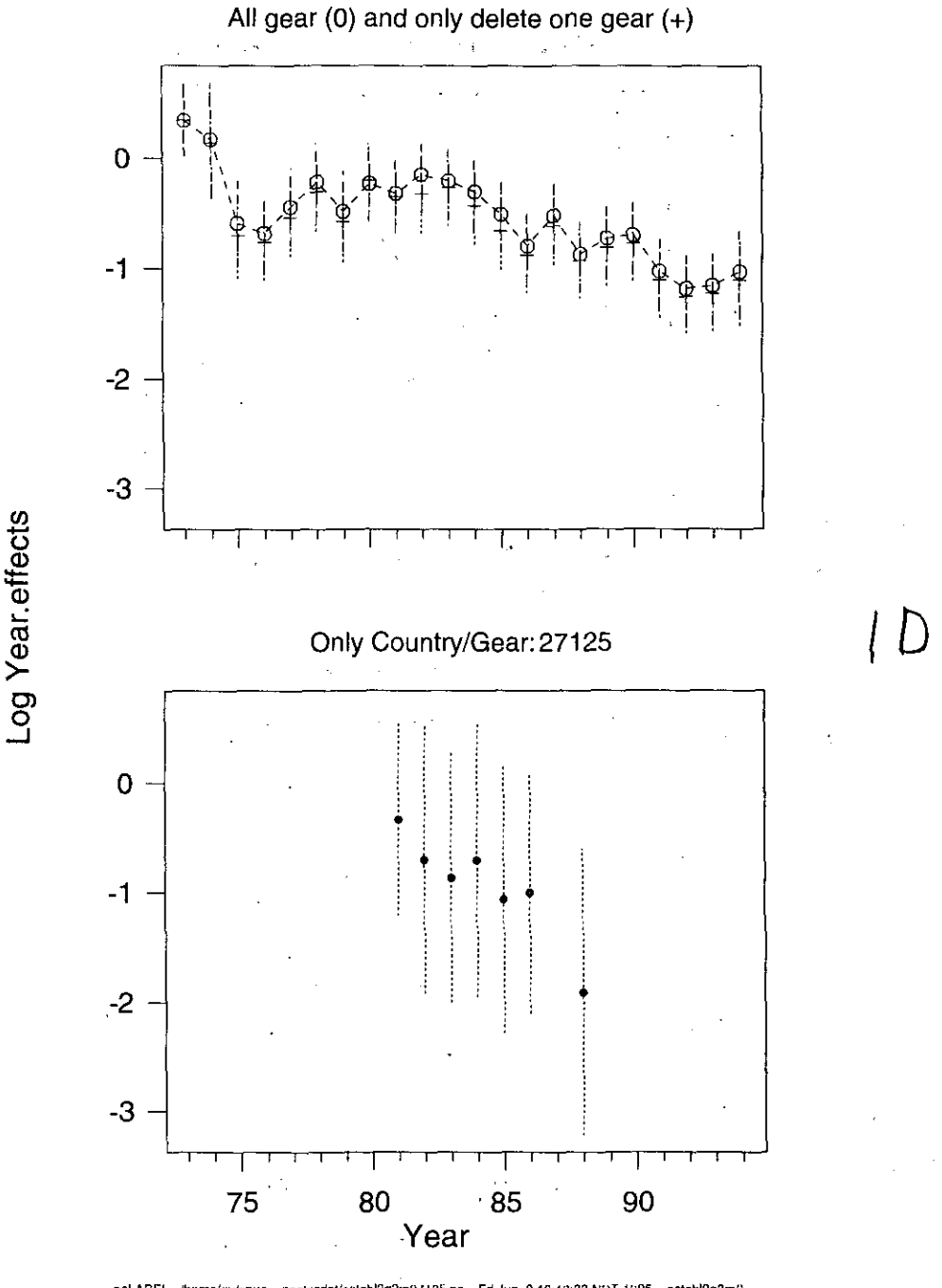
Country/Gear Deleted or Included:27125



1D

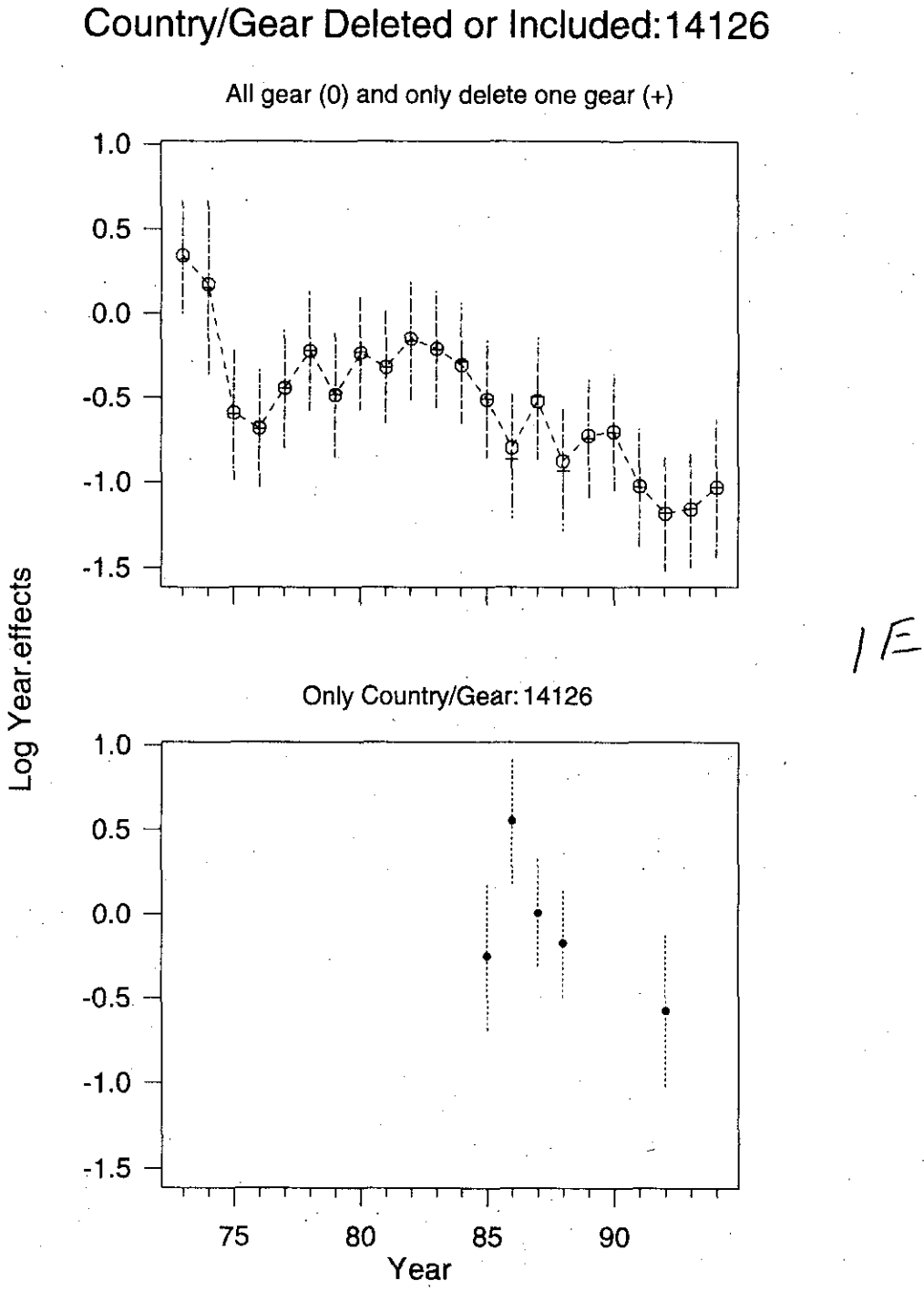


Fig. 1. The multiplicative analysis with equal weight given to all year/month/NAFO Div./country-gear strata. The upper panel shows the results if all data are included (open circles connected by dashed lines) and if the country/gear code listed at the top of the page is deleted (indicated by a plus). The lower panel shows the results of the analysis if only the country/gear class considered in the top panel is analyzed. The standard error of the estimates are given in all cases.

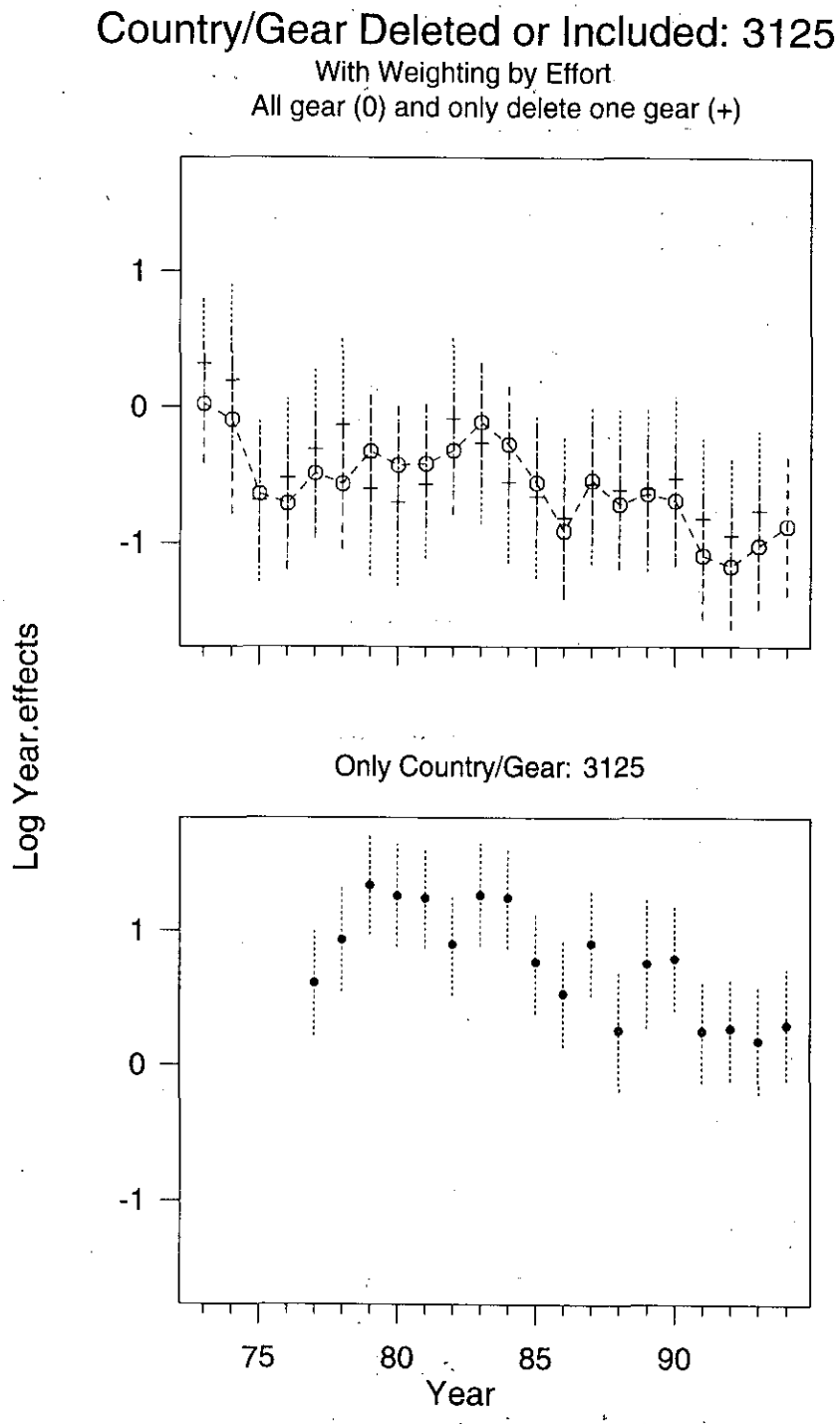


Fig. 2. Same as Fig. 1 except the strata are weighted by effort.