A Conversion of Squid Effort from Hours per Man to Man-Days and some Related Considerations

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Introduction

The South African jig squid fishery is a constant effort fishery, with the current unit of effort being one of man-hours. The target effort level is 3030 thousand man-hours based on recent assessment results, and the mechanism of effort control is to limit the number vessels (and crew) active in the fishery.

The long term rights allocation process resulted in 109 companies with a complement of 123 vessels (and 2233 crew) being granted rights in this fishery. 214 crew and 16 vessels have been set aside for appeals.

It is of concern that the target effort level has been exceeded in recent years (Figure 1), which suggests that the current restrictions on effort are not adequate. Measures that might be invoked to reduce effort include, for example, capping the days spent at sea, lengthening the closed season, introducing an additional closed season or combinations of these.

Queries have been raised recently about the reliability of information provided on hours-per-day fished in logbooks. A recent reanalysis of the jig CPUE on a catch per man-day rather than a catch per man-hour basis (WG/07/06/SQ3) has shown that this makes little difference to the trend of such CPUE data over time. However, given that there is more confidence in the reliability of the effort data provided by the logbooks on a per-day in contrast to per-hour basis, it would be desirable to convert the target effort level of 3030 thousand man-hours to man-days, which would also provide a more realistic basis for restriction from a compliance standpoint. This could be achieved by recalculating the target effort level with input of the new jig CPUE series in terms of per-day rather than per-hour effort units, but this would be a computationally intensive and lengthy process, which might in any case (see below) shortly need repetition given revised data. Hence as an interim approach, a simpler method to calculate a conversion factor between these two units of effort is attempted below.

The conversion calculation

The jig database (obtained from the National Marine Linefish System) formed the basis of this calculation. The effort calculation in terms of man-hours was restricted to records where the crew size was between 3 and 20 men, and where the number of hours and number of crew were reported.

A ratio, $r_y = \frac{\sum_{y,i=1}^{n} crew_{y,i} \times hours_{y,i}}{\sum_{y,i=1}^{n} crew_{y,i} \times days_{y,i}}$, was calculated, where each record in the database corresponds to a single day for a given vessel (i.e. the $days_{y,i}$ term in the equation is always unity). The resulting annual ratio values are shown in Figure 2. The average of these over the entire time period was 9.9. This implies that the current level of effort of 3030 thousand man-hours can be converted to man-days by dividing by 9.9 to yield an equivalent target level of effort of 306 000 man-days.

Sea-day limitations

Assuming (as for the computation of the target effort level) that there is a maximum effective fishing crew of 20 for vessels that carry more than 20 men, the crew complement in this fishery amounts to 2133 men. This implies that sea days should be capped at an average of 143 days (306 000 man-days/2133 men).

Closed season options

An extension of the closed season, or a further closed season, could be introduced. In WG/07/06/SQ3 a standardized catch/man-day index was derived. The GLM was of the form $ln(\text{catch/crew}) = \alpha + \beta_{year} + \gamma_{area} + \kappa_{month} + \eta_{vess} + \varepsilon$, where *year* is a factor with 21 levels (1985-2005), *month* is a factor with 12 levels, *area* is a factor with 274 levels and *vess* is a factor with 22 levels (Small, $Large_{1985}$, $Large_{1986}$…$Large_{2005}$) to account for the fact that larger vessels (> 16 crew) have been able to fish further offshore over time, and hence increase their average effort per day through having greater flexibility to change position during periods of poor weather inshore. ε is the error term, assumed to follow a normal distribution.

The exponent of the month factor is shown in Figure 3, and indicates that CPUE is highest over the November-January period. This information could be used to determine the relative impacts of closed periods at different times of the year. Such computations should also take account of the current distribution of man-days fishing over the season. Figure 4 shows the proportion of total man-days for the year that are fished in each month, for each of the last three years separately.

Reference

Glazer, J.P. and D. S. Butterworth. 2006. A re-analysis of the squid jig CPUE data. Unpublished MCM Working Group document, WG/07/06/SQ3. 5pp.

Figure 1: Effort expended in the South African jig fishery. The dashed line indicates the target effort level of 3030 thousand man-hours.

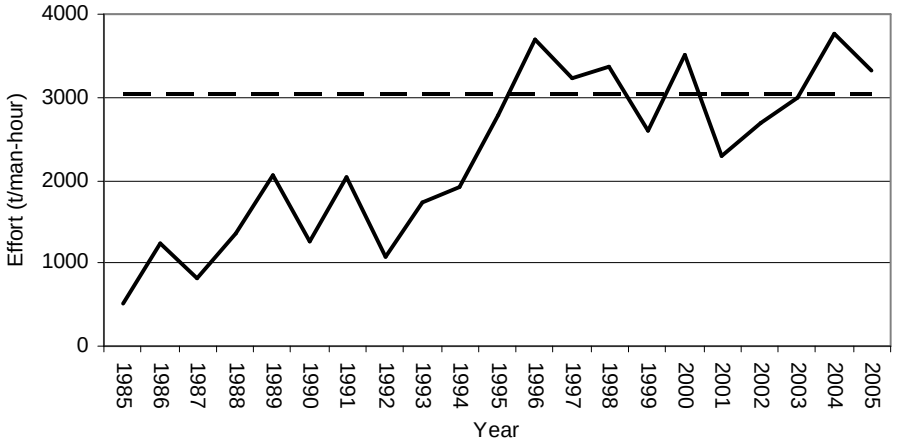

Figure 2: Ratio of man-hours to man-days per annum.

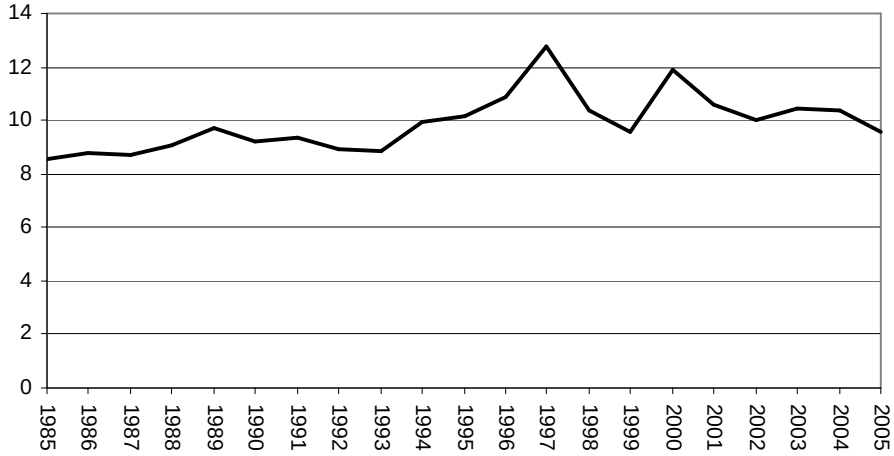

Figure 3: Exponent of the month effect from a GLM that models catch/man-day.

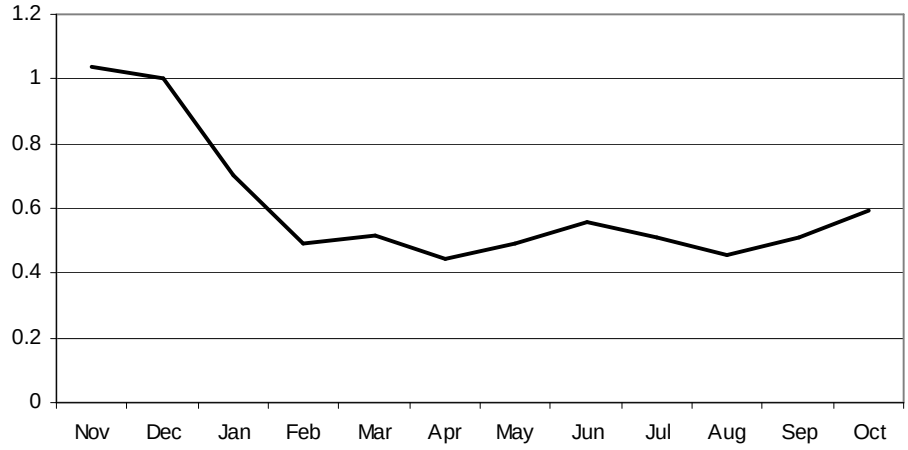

Figure 4: The proportion of total man-days fished per month over the last 3 years. The closed season in each year extended from mid-day 18 October to mid-day 22 November.