

Impact of sampling strategy on estimates of hake survey length distributions and the proportions of hake in the hake diet: a summary of work to date

A. Ross-Gillespie¹ and D.S. Butterworth¹

email: mlland028@myuct.ac.za

The hake cannibalism and inter-species predation model that is currently being developed by Ross-Gillespie and Butterworth has thus far failed to reflect both a biologically feasible estimate of daily ration and the proportion of hake in the diet of hake predators indicated by the diet data obtained during surveys. Andre Punt made a suggestion to investigate the sampling strategy used to obtain the diet data, in order to ascertain whether this strategy might be giving rises to biases in the estimates for the population as a whole of both the length distributions and the proportions of hake in the diet of hake predators. Technical details are not presented in this brief summary document, but the general lines of investigation can be summarised under three main headings.

Exploring alternative ways of estimating the hake survey length distributions

Currently, these distributions are estimated making the assumption that the hake population is homogeneously distributed across each depth stratum, and that each trawl in a given depth stratum represents a random sample from that stratum. All trawls thus receive the same weighting unless the samples size is very small. In reality, however, the hake population is not homogeneously distributed and it could be argued that the density of the fish population at the location of each trawl should be taken into account. This thinking has been used to re-estimate the length distributions. The initial impression from the results is that while there are some observable differences in the distributions resulting from the two approaches, the impact on key assessment results is likely to be minimal. This can, however, be verified only when the Rademeyer assessment models are re-run with the new probability-at-length distributions. More details and results on this matter will follow at a later stage.

Examining implications of the manner in which biological samples were collected

In earlier years, sampling instructions were to collect five specimens per length class for biological sampling (the primary target for sampling was otoliths). These samples could be collected across the depth strata. Since smaller fish are encountered more easily (relative abundance and availability to the survey) in waters < 300m, the focus of biological sampling at greater depths has generally been on larger fish in order to fill the overall sampling quota. In more recent years, the required size of the sample per length class was increased, and the quota per length bin has been reset for the second half of the cruise (T. Fairweather, *pers. comm.*). In plotting the length distributions from the total survey sample against the sub-sample for which biological information was measured, it has become evident that this sampling strategy may lead to instances where the biological samples are not representative of the length distributions of hake present in the stratum, especially for the earlier years (see Figure 1).

Proportion of hake in diet of hake predators

Given this (non-random) manner of biological sample collection, Punt's concerns whether these constitute an unbiased reflection of the hake population seem justified. The proportions of hake in the diet of hake predators have thus been re-evaluated, this time weighting the diet data from each stratum by the survey estimated population size from that stratum. Amongst key results is that the estimated proportions are lower for *M. capensis* than had been indicated by the data when analysed without stratum-weighting (see Figure 2). This may go some way towards resolving some of the problems experienced in the hake cannibalism and inter-species predation model, but again the impact will need to be assessed through re-runs of the model with the stratum-weighted data.

Technical details and further results will be presented at a later stage. Thanks go to Tracey Fairweather for patiently providing data and explanations throughout this process.

¹ MARAM (Marine Resource Assessment and Management Group), Department of Mathematics and Applied Mathematics, University of Cape Town, Rondebosch, 7701, South Africa.

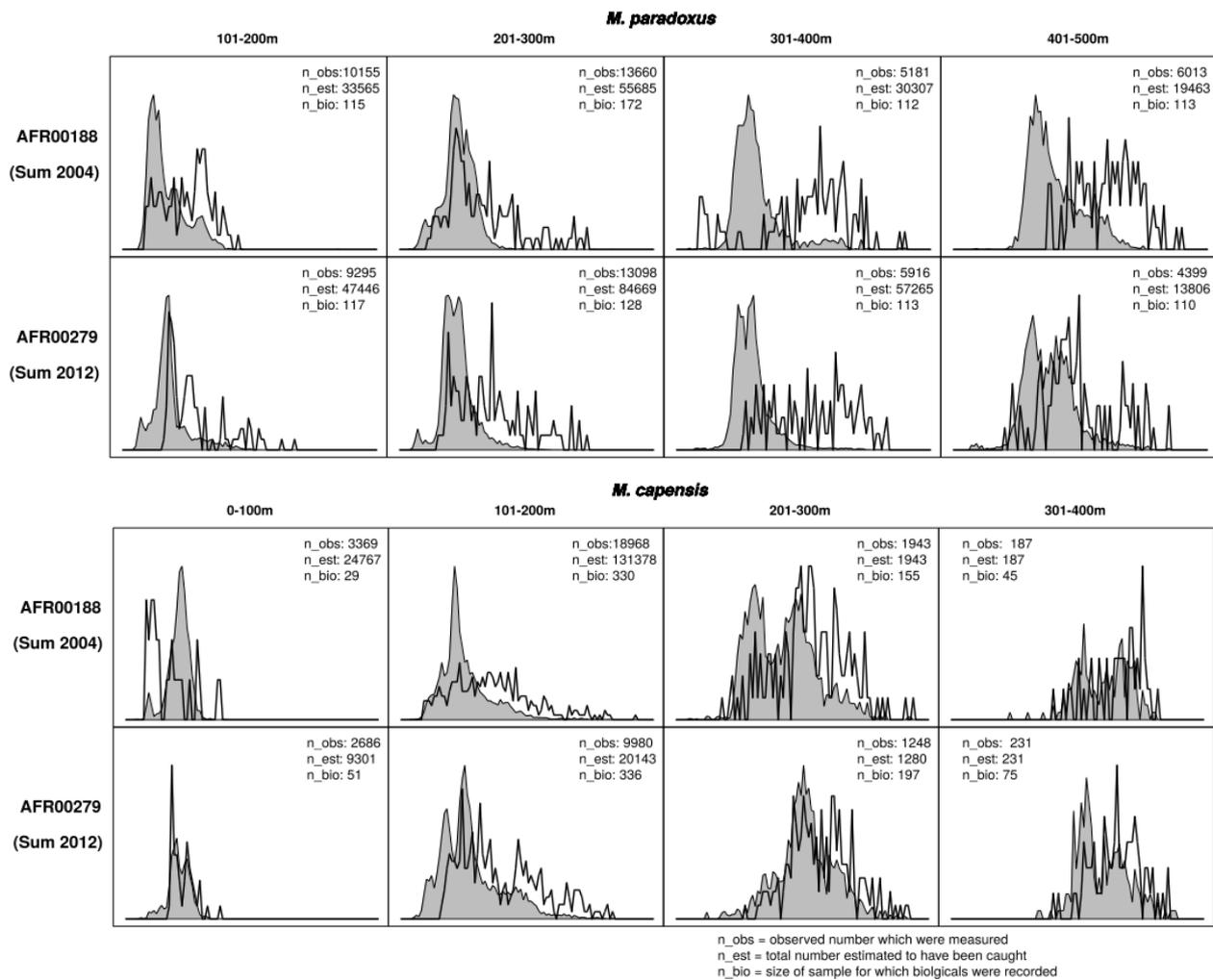


Figure 1: Comparison of estimated length distributions from surveys (grey shaded area) with the length distributions of the subsample of the survey catch from which biological information was collected (solid black lines). Distributions are shown for two cruises for illustrative purposes.

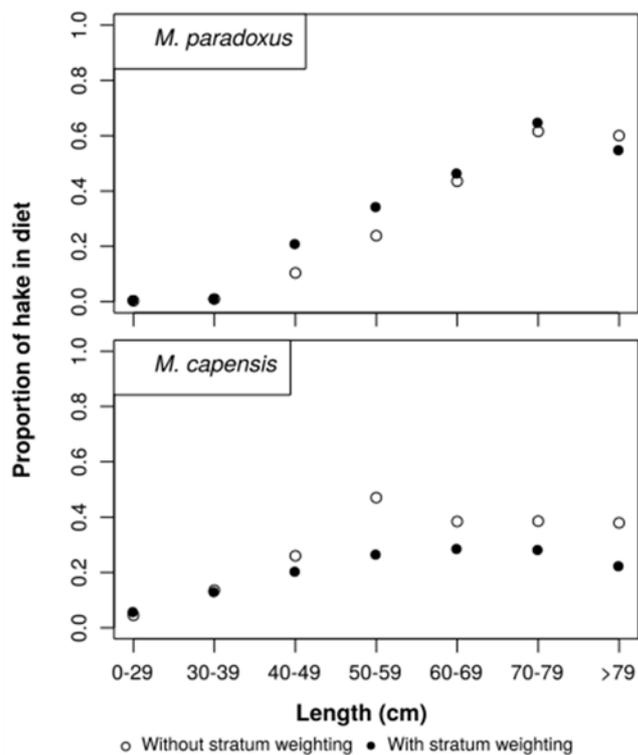


Figure 2: Proportion of hake in the diet of hake predators, as indicated by the diet data when abundance by depth stratum is taken into account, and when it is not.