Standardized catch rates of vermilion snapper from the headboat sector: Sensitivity analysis of the 10-fish-per-angler bag limit

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Introduction

For the SEDAR 17 stock assessment of vermilion snapper, standardized catch rates from headboat data were computed for 1976−2007. In 1992, a bag limit of 10 vermilion snapper per angler was implemented for the recreational sector (including headboats). A bag-limit regulation, if restrictive, is one reason why fishery dependent catch rates may not track relative abundance. This document describes sensitivity analyses designed to investigate the effects of the 10-fish vermilion snapper bag limit on standardized catch rates from headboat data.

Methods

Starting in 1992, with the implementation of a 10-fish bag limit for vermilion snapper, the percentage of headboat trips reporting 10 fish per angler rose generally to 7−11% per year, with a maximum near 18% (Figure 1). Concern was raised at the SEDAR 17 Data Workshop about whether a report of 10-fish per angler would accurately reflect the true number of vermilion snapper caught. Such a report might be an underestimate of the true number caught for at least two reasons: 1) headboat operators may not wish to document, in writing, a value that exceeds the regulation and 2) vermilion snapper caught in excess of the bag limit would be released, if caught on headboat trips that were in compliance with regulations.

Four different sensitivity analyses were conducted, designed to investigate the effects of underreporting on standardized catch rates from headboat data. In each analysis, five new data sets were created in which all reports of 10 fish per angler were replaced with a number drawn at random from a distribution, as described below. Then, the index of abundance was recomputed for each of the five data sets with the same delta-GLM method applied to the original data set (described in ch. 5 of the Data Workshop report).

Sensitivity analysis 1—If catch per angler was reported as 10 fish, catch per angler was replaced with a value drawn at random from the empirical distribution of reports with greater than 10 fish per angler (Figure 2A).

Sensitivity analysis 2—If catch per angler was reported as 10 fish, catch per angler was replaced with a value drawn at random from a lognormal distribution with mean equal to 20.6 fish and standard deviation equal to that of the empirical distribution (Figure 2B).

Sensitivity analysis 3—If catch per angler was reported as 10 fish, catch per angler was replaced with a value drawn at random from a lognormal distribution with mean increasing annually from 12.2 to 20.6 fish and standard deviation equal to that of the empirical distribution.

Sensitivity analysis 4—If catch per angler was reported as 10 fish, catch per angler was replaced with a value drawn at random from a lognormal distribution with mean decreasing annually from 20.6 to12.2 fish and standard deviation equal to that of the empirical distribution.

Sensitivity analyses 1 and 2 might be considered to represent lower and upper bounds on the actual fish caught per angler when reported as 10 fish, respectively. However, analyses 1 and 2 assume stationary distributions. Sensitivity analyses 3 and 4 relax the constraint of stationarity, by allowing the mean of the lognormal distribution to change annually, as might occur with increasing or decreasing trends in abundance.

Results

In each of the sensitivity analyses, there was little variation among indices computed from the five simulated data sets (in fact, these indices are difficult to distinguish visually). In each case, the original data resulted in a slightly higher index than did the simulated data before 1992, and it resulted in a slightly lower index after 1992. Differences between indices from the original data and from simulated data were smallest in sensitivity analysis 1 (Figure 3) and greatest in sensitivity analysis 2 (Figure 4), which by design was intended to be an upper bound. In reality, these differences would likely depend on annual variation of vermilion snapper abundance, as demonstrated by sensitivity analysis 3 (Figure 5) and sensitivity analysis 4 (Figure 6).

Conclusions

Based on these sensitivity analyses, the SEDAR 17 indices working group concluded that the 10-fish-per-angler bag limit, implemented in 1992, had only a small effect on the index of abundance computed from headboat data. Although there likely was some effect of the bag limit, it did not appear to justify truncation of the time series to remove all data from 1992 until present. Furthermore, the working group recommended using the headboat data as reported, rather than attempting to correct for underreporting as was done in these sensitivity analyses, because any correction would necessarily represent a hypothesis that could not be tested.

Figure 1. Proportion of headboat trips that reported catching 10 fish per angler, the bag limit implemented in 1992.

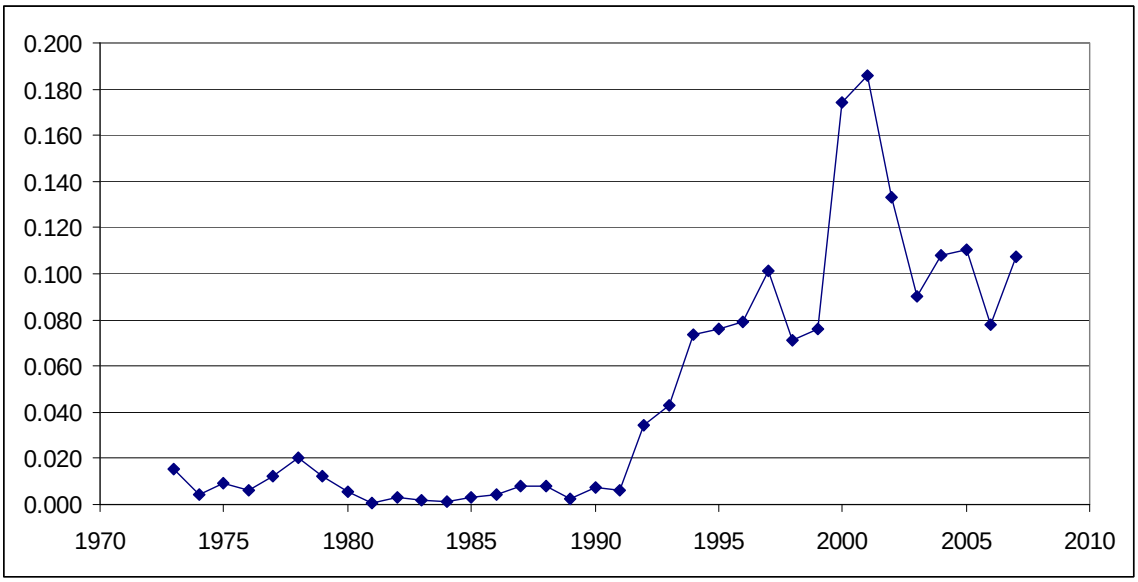

Figure 2A. Empirical distribution of vermilion snapper catch per angler (not including crew) that exceeded 10 fish, the bag limit starting in 1992. Values are from 1992−2007.

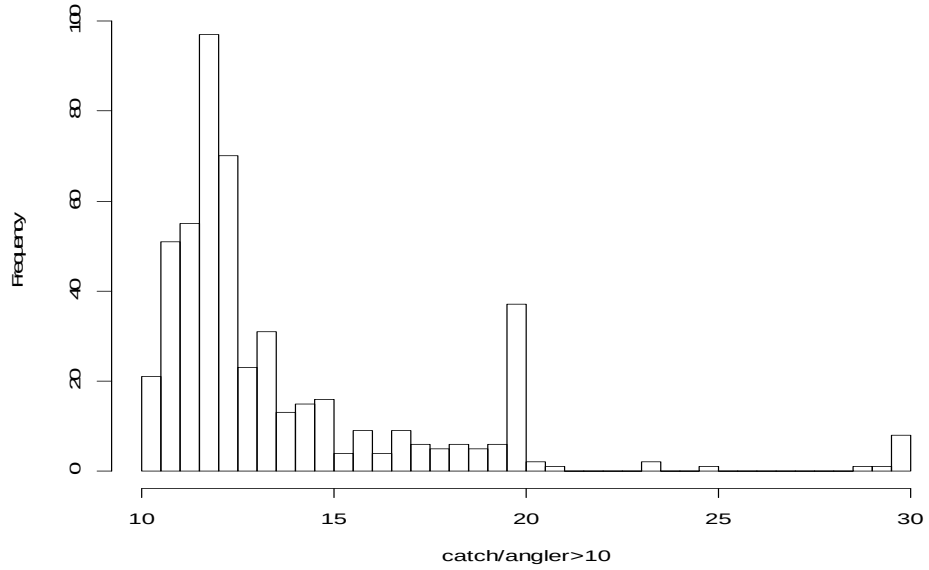

Figure 2B. Hypothetical lognormal distribution of vermilion snapper catch per angler as applied in sensitivity analysis 2 to trips that reported a catch of 10 vermilion snapper per angler.

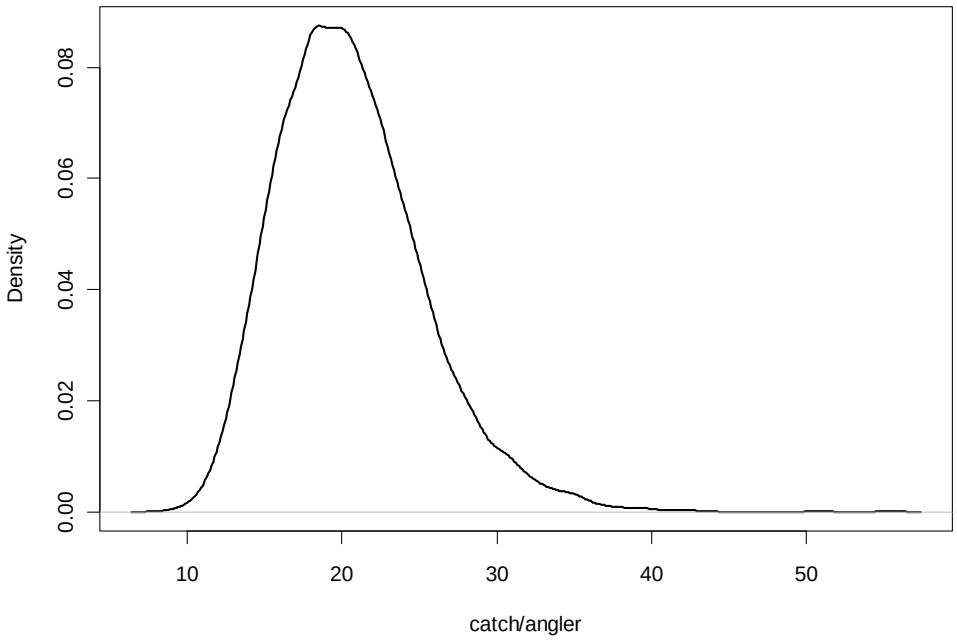

Figure 3. Results from sensitivity analysis 1, in which the catch from trips reporting 10 vermilion snapper per angler during 1992−2007 was replaced at random with a value from the empirical distribution of catch per angler exceeding 10 fish (shown in Figure 2A).

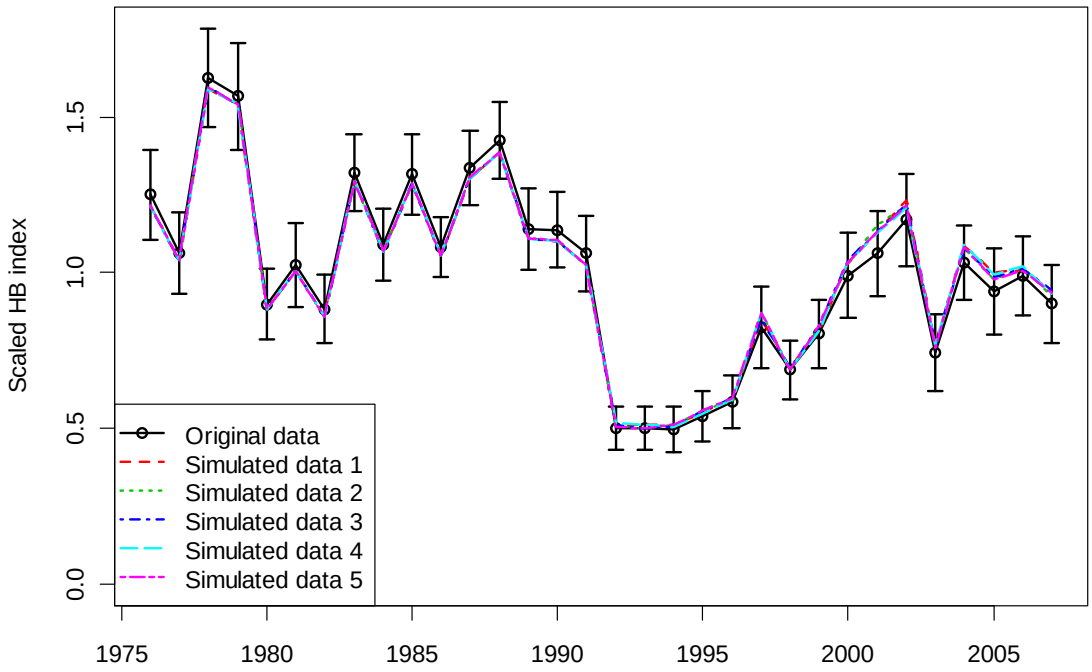

Figure 4. Results from sensitivity analysis 2, in which the catch from trips reporting 10 vermilion snapper per angler during 1992−2007 was replaced at random with a value from a lognormal distribution with a mean of 20.6 fish (shown in Figure 2B).

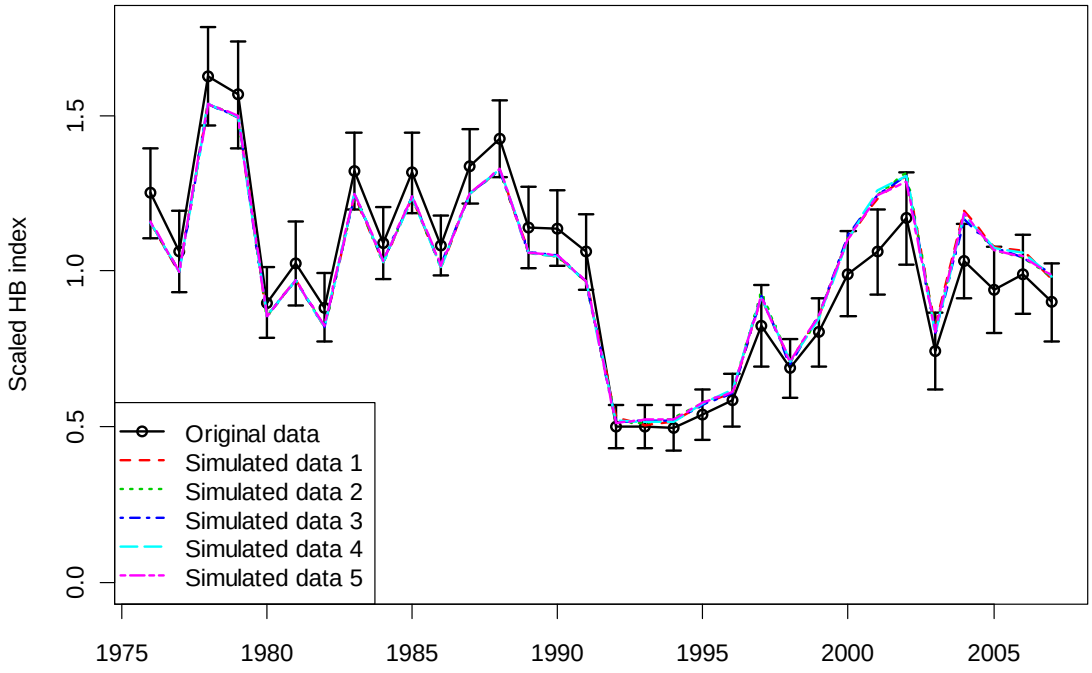

Figure 5. Results from sensitivity analysis 3, in which the catch from trips reporting 10 vermilion snapper per angler during 1992−2007 was replaced at random with a value from a lognormal distribution with an annually increasing mean, from 12.2 to 20.6 fish (2007 distribution shown in Figure 2B).

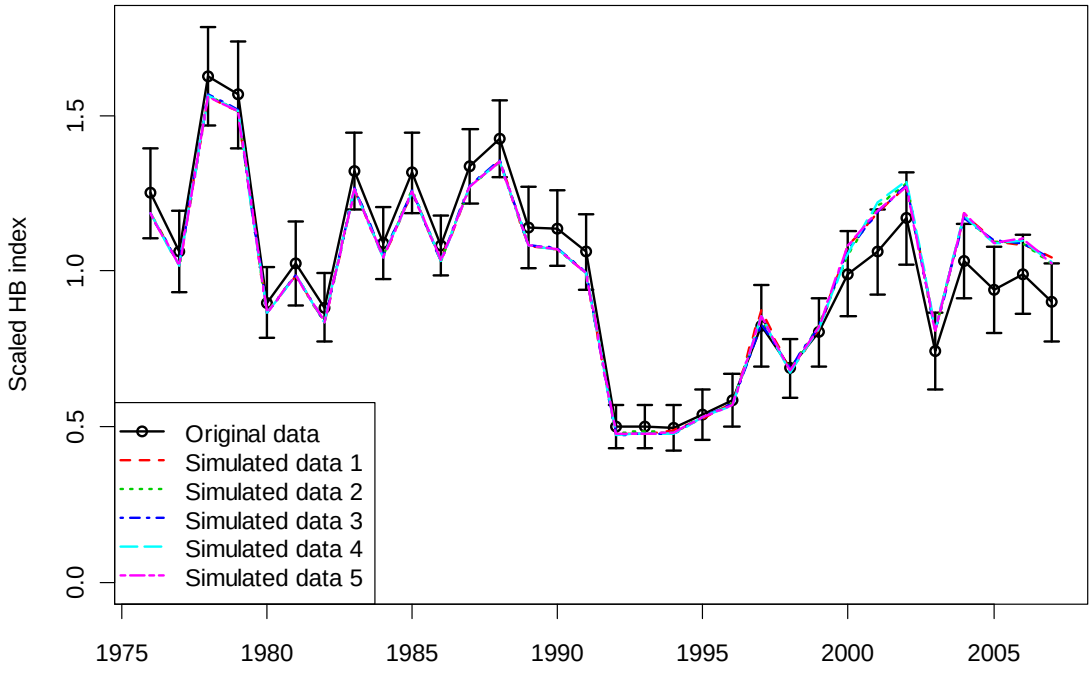

Figure 6. Results from sensitivity analysis 4, in which the catch from trips reporting 10 vermilion snapper per angler during 1992−2007 was replaced at random with a value from a lognormal distribution with an annually decreasing mean, from 20.6 to 12.2 fish (1992 distribution shown in Figure 2B).