

## The 2024 updated horse mackerel standardized CPUE

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An updated extract of the horse mackerel catch and effort data for the Desert Diamond from the observer database including the 2023 data.

Once the data had been re-extracted to include the zero catches, the following exclusions were applied to the data:

1. If the trawl time (End Date+ Haul Time - Start Date - Time Net On Bottom) was negative,  $\leq 5$  minutes or  $\geq 20$  hours
2. If the vertical mouth opening was  $< 50$  m or  $> 75$  m
3. If the trawl speed was zero or blank or  $>9$  knots

In 2016, a delta lognormal model incorporating an area effect was first used to allow for the inclusion of the large number of zero horse mackerel catch to the calculation of the CPUE (Singh, 2018). Two “areas” were demarcated as the area extending from Tsitsikamma to just east of Port Elizabeth and an area off Mossel Bay.

The CPUE standardization analysis described in this document used *Desert Diamond* catch and effort data covering the period from 2003 until 2023. Drag level catch and effort data for 2015 were not available for the analysis, as the two *Desert Diamond* trips were not observed in that year. The analysis was restricted to data from the area east of the 20°E line of longitude.

In 2021 an additional factor for device and no device was added. This factor was included in the 2024 analysis. Catch and effort data with the device present was added to the dataset from 2018 to 2023.

### The delta-lognormal model (area effect in red, device effect in green)

In the application of the delta-lognormal model two linear models are fit to the data: (i) a GLM to estimate the standardized CPUE for records with positive horse mackerel catches and (ii) a model to estimate the proportion of records for which there is positive catch.

The GLM applied to the data with positive catches is of the form:

$$\ell n(CPUE^{+ve}) = \alpha + \beta_{year} + \kappa_{month} + \gamma_{time\ of\ day} + \nu_{area} + \delta_{device} + \varepsilon \quad (1)$$

where the error distribution is assumed to be normal.

The model applied to the proportion of data with positive catches assuming binomially distributed errors is of the form:

$$prop^{+ve} = \alpha' + \beta'_{year} + \kappa'_{month} + \gamma'_{time\ of\ day} + \nu'_{area} + \delta_{device} + \xi \quad (2)$$

The following equation is applied to obtain standardized indices from modelling the positive catches (GLM), noting that the bias correction applied by Brandão and Butterworth (2004) is not applied here:

$$\widehat{CPUE}_{year,month}^{+ve} = e^{\hat{\alpha} + \hat{\beta}_{year} + \hat{\kappa}_{month} + \hat{\gamma}_{standard\ time\ of\ day} + \hat{\nu}_{area} + \hat{\delta}_{device}} \quad (3)$$

The following equation is applied to obtain standardized indices from modelling the proportion positive catches (assuming a binomial error distribution):

$$\widehat{Prop}_{year,month}^{+ve} = \frac{\exp(\hat{\alpha}' + \hat{\beta}'_{year} + \hat{\kappa}'_{month} + \hat{\gamma}'_{standard\ time\ of\ day} + \hat{\nu}'_{area} + \hat{\delta}_{device})}{1 + \exp(\hat{\alpha}' + \hat{\beta}'_{year} + \hat{\kappa}'_{month} + \hat{\gamma}'_{standard\ time\ of\ day} + \hat{\nu}'_{area} + \hat{\delta}_{device})} \quad (4)$$

The standard time of day is selected to be the time of day category which contains most of the data.

The overall standardized CPUE is then the product equations (3) and (4):

$$\widehat{CPUE}_{year} = \sum_{month} (\widehat{CPUE}_{year,month,area,device}^{+ve} \times \widehat{Prop}_{year,month,area,device}^{+ve}) / \sum_{month} 1 \tag{5}$$

The updated Desert Diamond standardized CPUE time series arising from these calculations is illustrated in Figure 1.

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**References**

Singh L (2018) The 2018 updated horse mackerel standardized CPUE. FISHERIES/2018/OCT/SWG-DEM/53.3pp

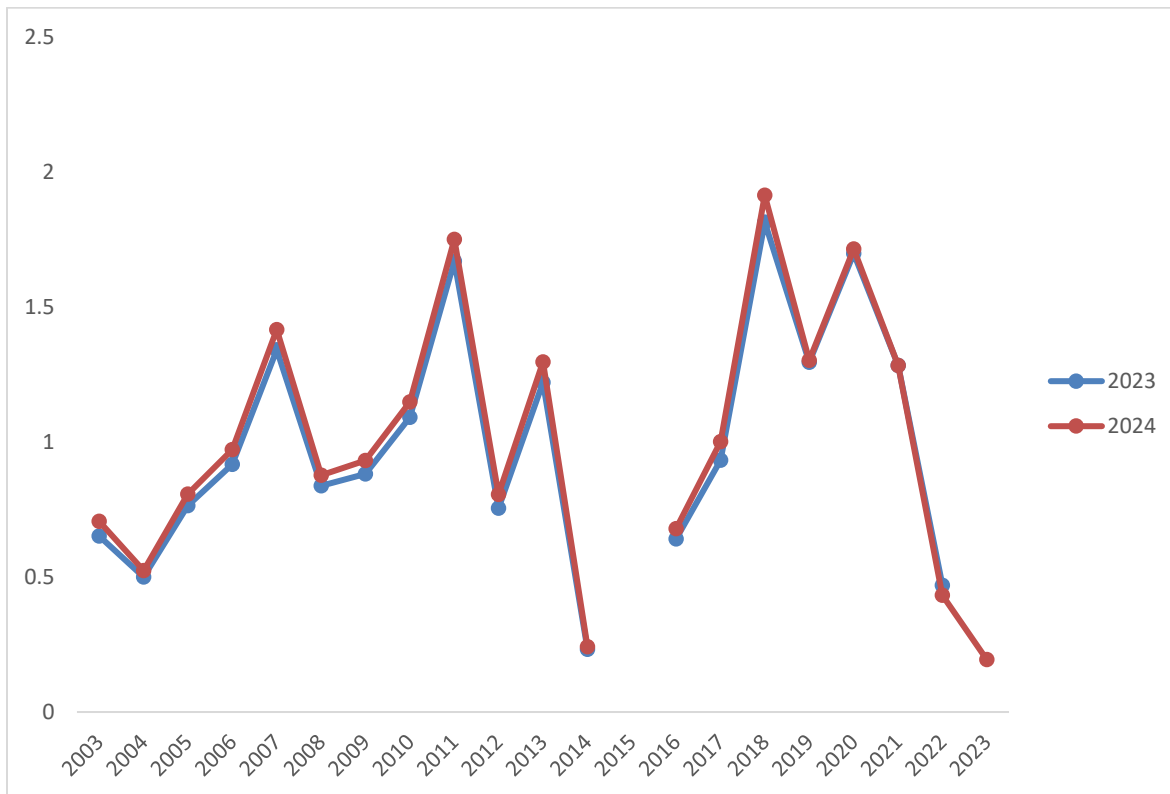


Figure 1: Standardized CPUE for horse mackerel with area and device effect 2003-2023 excluding 2015.