

## 9<sup>th</sup> MEETING OF THE SCIENTIFIC COMMITTEE

*Held virtually, 27 September to 2 October 2021*

SC9-WP05\_rev1

### Additional Information regarding the Peruvian CPUE abundance index in SC9-Doc23

*IMARPE - Peru*

This working document was produced in response to requests for clarification made during the SC9 session

#### Background

The standardized CPUE for the Peruvian fleet targeting on jack mackerel (*Trachurus murphyi*) in the Peruvian jurisdictional waters is used as an abundance index in the assessment of the Far North stock. Prior to 2018, the CPUE was estimated using only the information from the industrial purse-seine fleet, which is known to target on jack mackerel mainly when the anchoveta (*Engraulis ringens*) fishing season is closed, and when fishing for jack mackerel (with different gear) it also targets indistinctly chub mackerel (*Scomber japonicus*) and/or bonito (*Sarda chiliensis*). Since 2018 (SC benchmark assessment), the information of the artisanal and small-scale fleets have been incorporated into the estimation of the CPUE. These fleets are known to be more consistent in targeting on jack mackerel all year round, even if the total volume of their catches tend to be much lower than those of the industrial purse-seine fleet. Details of the estimation process of this new CPUE were presented in Document SC6-Doc20, Section 5.2.1. Additional mentions about this CPUE were made in Jack Mackerel Technical Annexes of the SPRFMO SC6, SC7 and SC8 Meeting Reports. This note is a very brief summary of the technical aspects of the Peruvian CPUE estimations, with frequent cut and pasting from some of the abovementioned reports.



## Data and method

The data used correspond to a sample of trips carried out by the industrial and artisanal fleets from January 2002 to June 2021. For each trip, information was available on the catch, year, month and the vessel holding capacity. The number of trips used per year are annotated in the following table.

Year/Fleet	Art	Ind	Total
2002	1910	543	2453
2003	1774	743	2517
2004	1745	552	2297
2005	1101	447	1548
2006	2842	1029	3871
2007	2364	414	2778
2008	1605	257	1862
2009	1045	45	1090
2010	370	7	377
2011	1339	458	1797
2012	2181	249	2430
2013	1072	53	1125
2014	2341	59	2400
2015	2290	0	2290
2016	2180	0	2180
2017	2981	0	2981
2018	36	71	107
2019	474	252	726
2020	2324	249	2573
2021	1412	225	1637

The method used for the standardization of the CPUE was a GAM model, in which the dependent variable is the catch per trip (gamma-distributed using a log-link function) and the explanatory variables were the year and month (temporal effects) and hold capacity (operational effects).

Catch ~ year + month + hold capacity

## Results

Model diagnostics is presented below:

Family: Gamma

Link function: log

Formula:

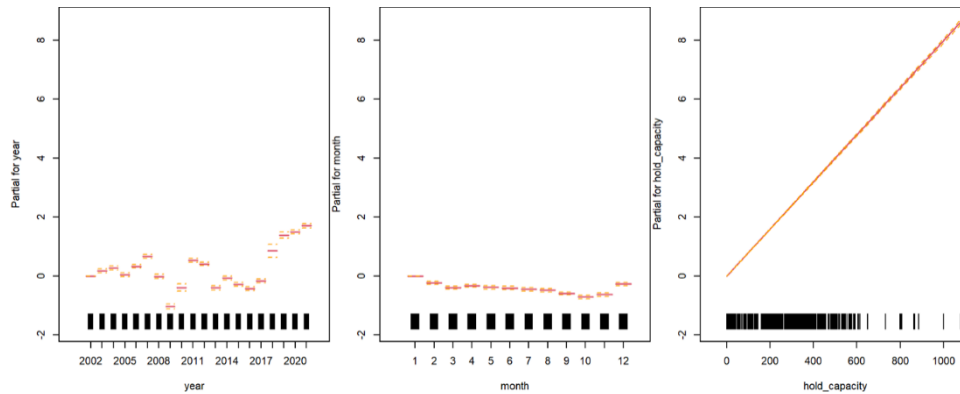
catch ~ year + month + hold\_capacity

Parametric Terms:

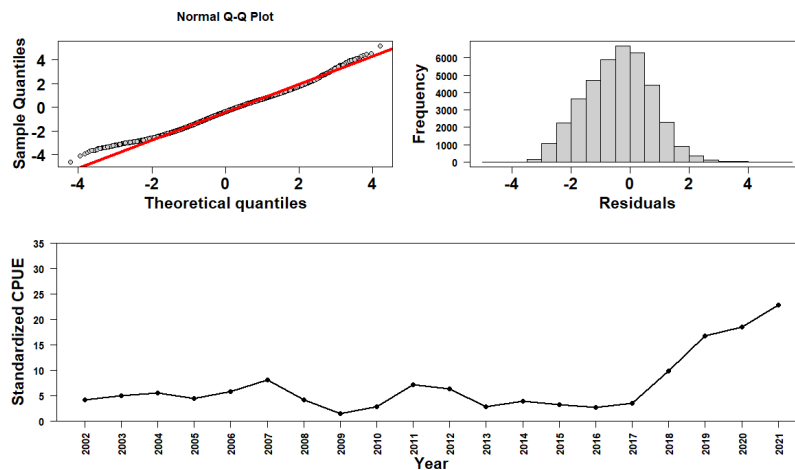
	df	F	p-value
year	19	595.20	<2e-16
month	11	96.25	<2e-16
hold_capacity	1	51346.00	<2e-16



The behavior of factors for each variable used in the standardization model are presented in the following figure.



Distribution analyses of the standardized CPUE and time series are presented in the next figure.



Differences in CPUE estimations for 2020, as presented in Document SC9-Doc23 (Figure 18), are due to the number of trips used in each update. During the first update (June 2020) the 2020 CPUE was estimated using data coming from 669 trips, mainly made by the industrial fleet; during the second update (December 2020) we used data from 749 trips, which included data coming from the industrial fleet and partially from the artisanal fleet; and during the third update (June 2021) we used a more complete database (2 574 trips) coming from the industrial and artisanal fleet. For the estimation of the partial value of 2021 CPUE (made in June of 2021), we have used data coming from 1 637 trips, mainly made by the industrial fleet and partially by the artisanal fleet. It is noted that the delays in the arrival of some data was mostly a side effect of lockdowns and social distancing precautionary measures adopted due to the Covid-19 pandemic.

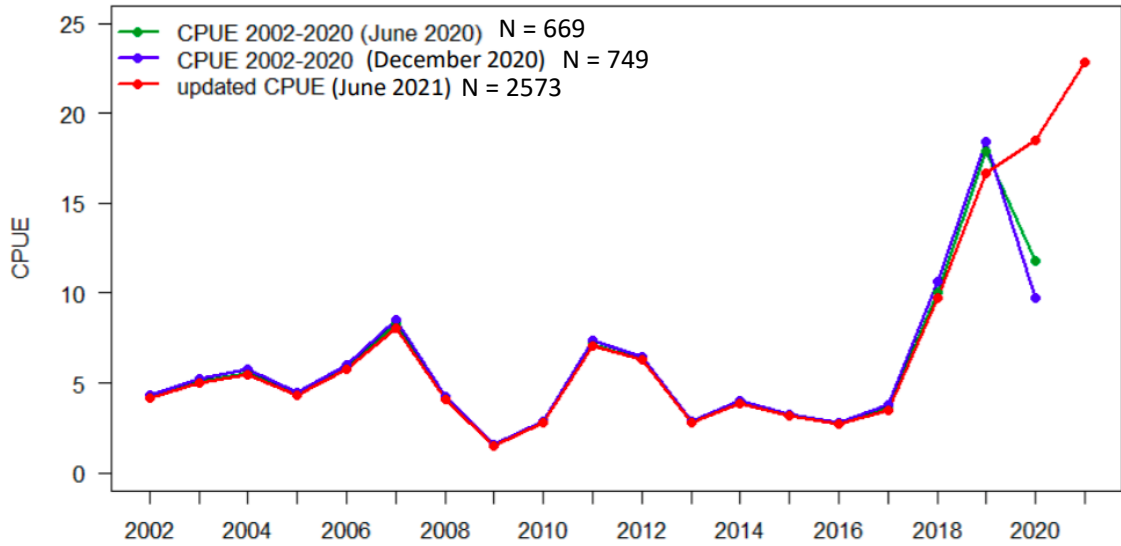
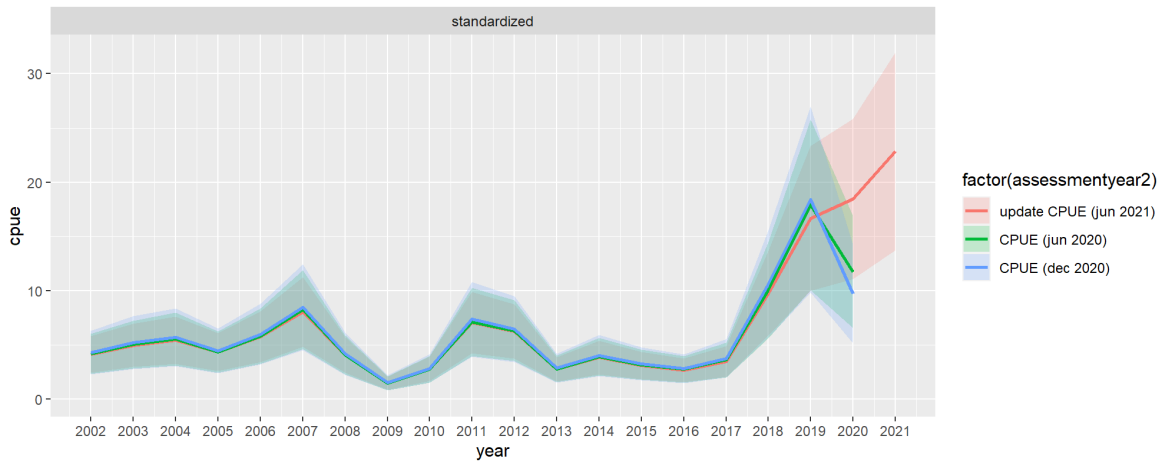


Figure 18.- Updated CPUE time series of Jack mackerel *Trachurus murphyi* caught in Peruvian jurisdictional waters by the industrial and the artisanal and small-scale fleets between 2002 and 2021

Standardized CPUE with confident intervals are presented in the next figure.



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