AI-powered data-limited stock assessment method more accurate than 'gold standard' in predicting sustainable catches

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Fishers in Bagamoyo, Tanzania. Credit: Rasheedhrasheed, Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Bagamoyo_ferry.jpg

A recent update introduced to the [CMSY methodology](#) used to assess the status of fish stocks has proven to more accurately predict the catch that a population can support than highly-valued data-intensive models.

In [a paper](#) published in the journal *Acta Ichthyologica et Piscatoria*, the international team of researchers that shaped the improved CMSY++ model noted that its results better correspond with what is, in reality, the highest catch that a [fish stock](#) can support in the long-term, given that environmental conditions do not change much.

Now powered by an artificial neural network that has been trained with catch and biomass data of 400 stocks to identify plausible ranges of the initial and final state of the stocks being assessed, CMSY++ allows managers and scientists to input only catch data to estimate [how many fish are left](#) in a given [stock](#) and how much fishing pressure can be applied.

Maximum sustainable catches or yield (MSY) is a concept developed in the 1950s by US fisheries scientist M.B. Schaefer who proposed that if fishers left in the water a biomass equivalent to at least 50 percent of the unexploited fish population, that is, of the biomass it had before being commercially exploited, then the highest possible catches could be sustained over time.

"By comparing the results of CMSY++ to models that are considered superior because they require large amounts of initial data inputs, such as the Fox surplus-production model and the Stock Synthesis (SS3) age-structured model, we noticed that these models badly overpredicted the catch that a [population](#) can support when [previous overfishing](#) has reduced it to a small fraction of its natural size, as is the case with most exploited [fish populations](#) in the world," said Dr. Rainer Froese, lead author of the study and a senior scientist at the GEOMAR Helmholtz Centre for Ocean Research.

In other words, the model underlying the CMSY++ method fitted the observed data, while the predictions of the 'gold standard' models were too optimistic in estimating sustainable catches.

"These models tend to estimate the biomass required to produce maximum sustainable yields as less than half of unexploited biomass, which is lower than M.B. Schaefer originally proposed based on the widely observed S-shaped growth curve of unexploited populations or population size that the ecosystem would normally accommodate," said Daniel Pauly, co-author of the study and principal investigator of the Sea Around Us initiative at the University of British Columbia. "This finding could explain the often-observed failure of fisheries managers to maintain or rebuild depleted stocks even when the predictions of the gold standard models were followed."

More information: Rainer Froese et al, New developments in the analysis of catch time series as the basis for fish stock assessments: The CMSY++ method. *Acta Ichthyologica et Piscatoria* (2023). DOI: 10.3897/aiep.53.e105910

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