Benchmarking the ability of different stock-assessment models to capture the highly-fluctuating dynamics of small pelagics

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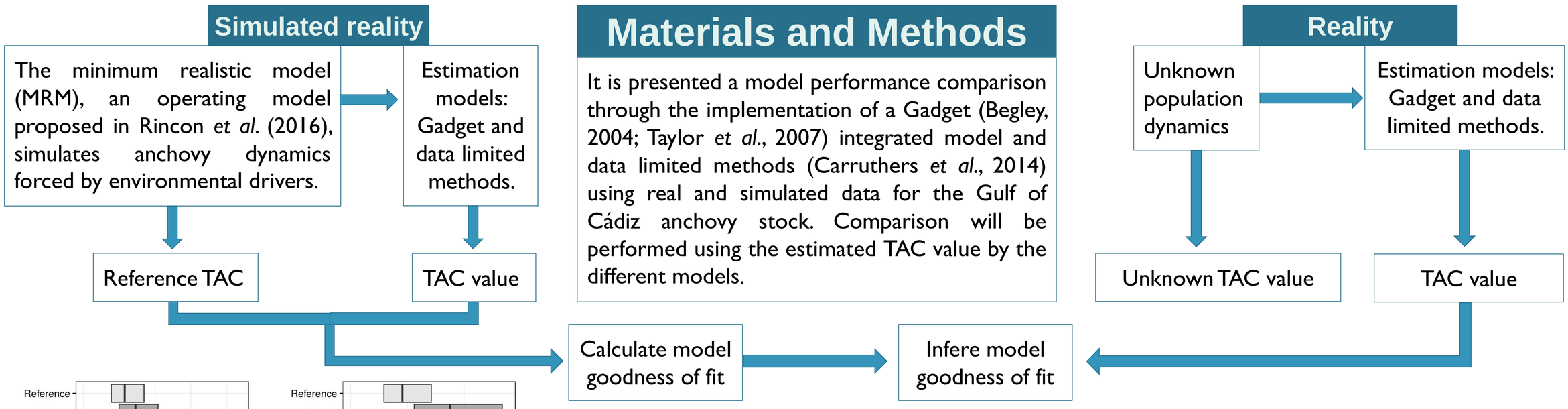
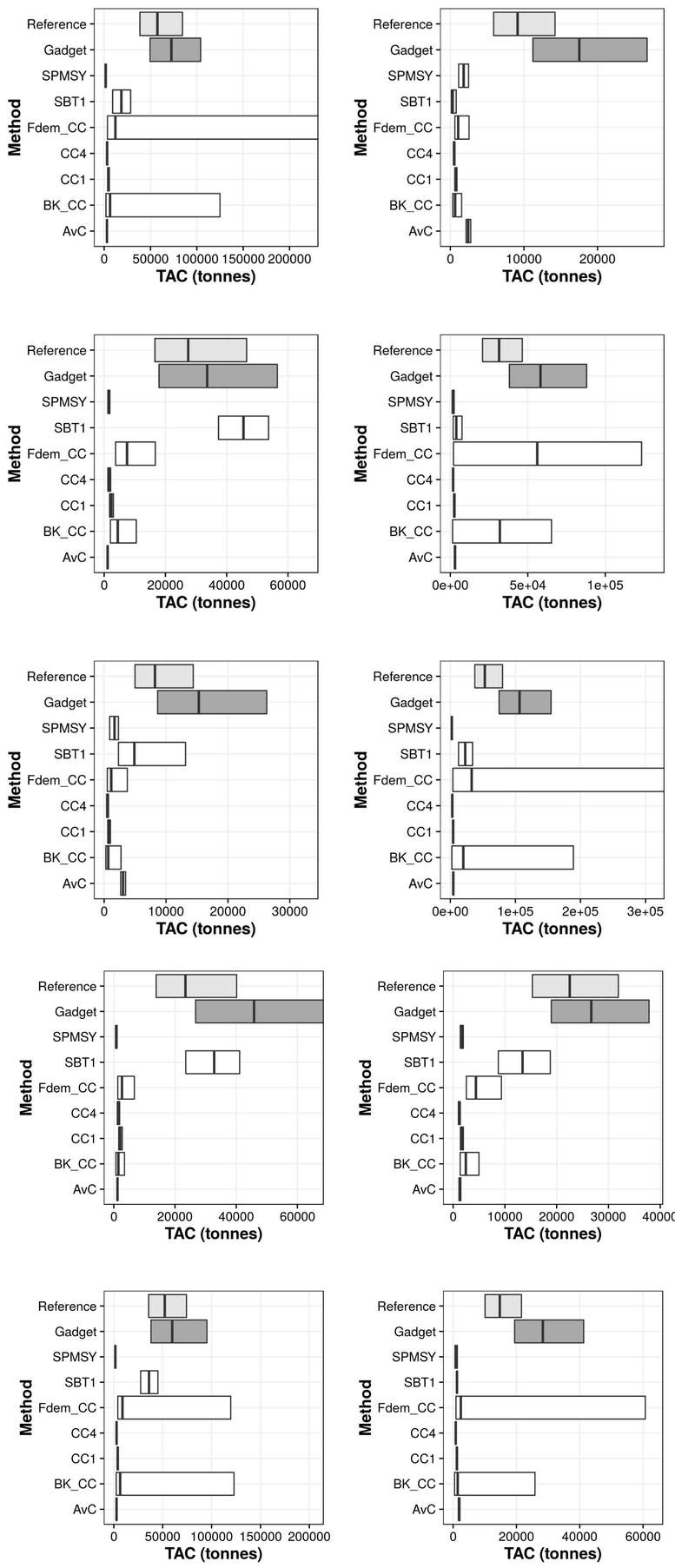
Introduction and aims

Small pelagics dynamics are characterized by extreme variability owing to environmental factors, fishing and natural mortality (Fréon *et al*., 2005). Anchovy (*Engraulis encrasicolus*) in Gulf of Cádiz is affected by this variability owing to environmental drivers, that exert a bottom control, and fishing pressure that exerts a severe control of the population from the top (Ruiz *et al*., 2007). Because of highly-fluctuating dynamics and lack of data, it is difficult to evaluate the stock status through models (ICES, 2016). To assess these evaluation difficulties, a model comparison framework based on the Management Strategy Evaluation (MSE) approach has been developed and tested in the Gulf of Cádiz anchovy stock to measure models capacity to support an ecosystem approach to fisheries management (EAFM).

Materials and Methods

It is presented a model performance comparison through the implementation of a Gadget (Begley, 2004; Taylor *et al*., 2007) integrated model and data limited methods (Carruthers *et al*., 2014) using real and simulated data for the Gulf of Cádiz anchovy stock. Comparison will be performed using the estimated TAC value by the different models.



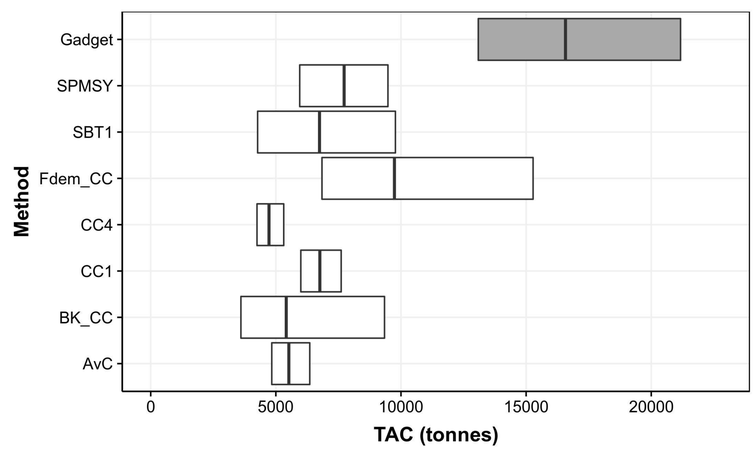


◀ **Figure 1.** Comparison of TAC values derived from Gadget and other methods with a reference simulated population

Results

TAC values for 10 different simulations comparing Gadget and other models performance against the reference were shown in Figure 1. In most of the simulations the implementation of data limited methods results in a more precautionary TAC than the calculated with Gadget. By the use of boxplots, it is possible to directly compare models using the difference between estimates. In almost all boxplots there is a higher difference between other methods estimates and the reference compared to Gadget.

With real data, Figure 2 clearly shows a significant difference between Gadget and others methods estimates.



▲ **Figure 2.** Comparison of estimated TAC value between a Gadget model and other models.

Discussion

The results of this work indicate that **Gadget calculates better TAC estimates than the other methods in most of the simulations**. This high estimation power of Gadget suggests that, as integrated model, is able to use multiple sources of information at the same time. Moreover, Gadget seems to account for the effect of external variability sources because the Gadget TAC estimate was very close to the reference in most of the cases, and this reference was simulated by an operating model that includes environmental drivers (Figure 1).

The general approach based on the Management Strategy Evaluation has demonstrated to help to develop a methodology that could be used to improve the quality of management. In fact, this strategy could be applied to test if existing methods have the ability to capture the true status of the system with appropriate accuracy (Butterworth, 2007; Punt *et al*., 2016). This work emphasizes a methodology that is flexible enough to be used with different models in other fisheries assessments.

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MareFrame

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