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COMMENTARY AND CORRESPONDENCE

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Comments on the evidence for the recent claim on the state of Australian fish stocks

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We reject the claim made by Edgar, Ward, and Stuart-Smith (2018) that Australian fish stocks are rapidly declining. Extrapolating survey results from shallow inshore areas to the continental shelf and slope is invalid, and the broader examination of Australian fisheries involves analytical deficiencies and factual errors.

The analytical deficiency concerns the use of catch-only methods to infer stock status. Extensive analysis has indicated that methods that use only catch data typically have much higher uncertainty than those based on model-based estimation methods (Carruthers et al., 2014). Part of the reason is that catches are influenced by many factors other than abundance, including markets, changes in fisher behaviour and management arrangements. In Australia, for example, catches of one of Australia's most valuable finfish fisheries (blue grenadier) decreased by more than 50% from 2013 to 2016. The large reduction in this Marine Stewardship Council-certified fishery can be attributed to a single vessel not fishing, and not a decline in abundance.

In contrast to catch-only methods, stock status in many Australian federal- and state-managed fisheries is determined using population dynamics models and statistical estimation methods, informed by multiple data types. Such assessments take into account many of the factors affecting abundance.

The two approaches are therefore at the heart of the different interpretations regarding the state of Australian fisheries, and the results of Edgar et al. (2018) do not enhance understanding regarding the state of Australian fish stocks, but rather emphasize that catch-based appraisals have associated caveats that should be considered. For example, while Edgar et al. (2018) suggest that catch-based analysis could be biased, they conclude without adequate analysis that the bias is minor. Since this bias is critical to the validity of the results and conclusions, we argue it deserved, and deserves, better scrutiny.

The factual errors of Edgar et al. (2018) concern the decision-making process in the Southern and Eastern Scalefish and Shark Fishery (SESSF), which they claim is supported by the most transparent decision-making process amongst Australian fisheries. We would like to correct their statement that both pre-exploitation biomass B_0 and current biomass B_{cur} are reported for only two stocks in that fishery. In fact, it is standard practice in that fishery and others in Australia for all model-based stock assessments to report both values.

We would also like to correct the statement that the 2015 catch of eastern school whiting (*Sillago flindersi*) managed by the SESSF under several names (http://www.afma.gov.au/portfolio-item/eastern-school-whiting/) was 166% of the total allowable catch (TAC). Comparing catches with TACs in this fishery is complicated because catches are often reported by calendar year, whereas TACs apply to a management year, from May to April. Thus, the TAC of (eastern) school whiting for the period from May 2015 to April 2016 was set at 747 t (http://www.afma.gov.au/wp-content/uploads/2015/12/FINAL-21-DEC-2015-AFMA-TAC-2016-17-recommendations-to-SEMAC.pdf), whereas catches over that period in the following year were reported as 733 t (http://www.afma.gov.au/wp-content/uploads/2017/02/Agenda-Item-2.1-AFMA-TAC-recommendations-for-2017-18.pdf), below the TAC. The value of 166% was likely the result of Edgar et al. (2018) mistakenly combining state and federal catches for comparison against the federal TAC alone.

Edgar et al. (2018) also exemplify jackass morwong to highlight uncertainty associated with stock assessments. Punt et al. (2018) published a complete retrospective analysis summarizing assessment uncertainty across SESSF stocks assessed multiple times, which suggests that some assessments are highly variable and others not.

The allegation that the 2008 Recommended Biological Catch (RBC) of jackass morwong was changed retrospectively from 0 t to 410 t in 2015 is incorrect. Eastern and western parts of the stock have been assessed separately since 2007, and the combined RBCs are reported to the Australian Fisheries Management Authority and serve as the basis for a single TAC. The citation used by Edgar et al. (2018) states that the original 2008 RBC for the east was 0 t, the west was 410 t, and the combined east and west RBC was 410 t (http://www.afma.gov.au/wp-content/uploads/2010/06/SESSF-2013-Part-1-Final.pdf, p. 155, table 8.2). It does not show that the 2008 RBC was 0 t and was changed retrospectively to 410 t, but was possibly misread by Edgar et al. who appear to have confused the combined with the eastern RBC.

Edgar et al. (2018) are correct that management of jackass morwong operates on the assumption that the stock has undergone a 'recruitment shift', which reduced the carrying capacity of the stock. That decision was based on the use of several indicators and a risk analysis published in the peer-reviewed literature (Wayte, 2013). Although a consequence of this assumed recruitment shift was a higher immediate TAC, it also implied a long-term reduction in catch given the estimated lower productivity and the applied harvest control rule.

Although the RAM Stock Assessment Database is the most complete summary of fish stock abundance worldwide, care should be exercised when interpreting results for Australian stocks. Only 22 or 24 Australian stocks—the numbers differ in Edgar et al. (2018) between the legend of Figure 3a and the text—out of a potential 294 stocks (http://www.fish.gov.au/) are covered in the database. Importantly, only five submissions occur after the implementation of the Australian federal Commonwealth Harvest Strategy Policy, which set three major initiatives:

1. recover overfished stocks and prevent future overfishing;
2. reduce excess effort through a government buy-out; and
3. implement a network of marine protected areas in south-eastern Australia.

We also agree that spatial management is a core component of managing marine resources. However, whether it is no-take marine protected areas or fishery closures depends entirely on the management objectives.

Lastly, although we are critical of Edgar et al. (2018) for the reasons outlined, we acknowledge that they raise two valid concerns. First, although not representative of Australian fisheries as a whole, the shallow water inshore survey trends reported in the paper are likely valid and should be of concern. Fishery-independent survey data are rare for Australian fisheries, and appropriate use should be made of the data we do have, including those reported by Edgar et al. (2018). Second, a thorough audit and analysis of the reasons for the decline in commercial catch is important, so long as it uses appropriate methods of analysis. Edgar et al. (2018) make the claim that inputs to stock assessments are often narrow and exclude information and insights from marine ecologists. Although this is not generally the case, we acknowledge that a more fruitful collaboration between fishery scientists and marine ecologists could yield substantial benefits in exploring the issues raised and in addressing the two points noted in this paragraph. Such collaborations have previously shown benefits for similar analyses at an international level.

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