THE UNIVERSITY OF QUEENSLAND
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**RRAT Committee: Inquiry into the identification of leading practices in ensuring evidence-based regulation of farm practices that impact water quality outcomes in the Great Barrier Reef.**

**Question on Notice, Senator Carr: "Could you please respond to the proposition that the Clark et al. paper demonstrates that there is a crisis in scientific replication?"**

Dear Senator Carr,

The putative "replication crisis" was mentioned at the inquiry by Senator Roberts and others. According to Senator Roberts, a published study by Clark and colleagues tried to repeat eight experimental studies published by scientists at James Cook University and found that "*all were wrong, 100 per cent."* According to Senator Roberts, this is evidence of a fundamental crisis in scientific replication.

Nothing could be further from the truth. The questions posed by Senator Roberts invariably show a complete misunderstanding of the scientific process. Science is not simply based on mindless repetition but rather a broad array of ideas, perspectives, experimentation, anonymous peer review of manuscripts, publication, continued critique by global peers: a total process that leads to refinement of knowledge, improved understanding of even the most complex of problems, and ultimately improvement in the condition of our planet and living systems.

The antithesis is the cherry picking of information to supposedly highlight deficiencies. Senator Roberts refers to corruption of science while himself amply demonstrating his point. Perhaps even more to the point, he has missed the fact that Clark et al. did not actually replicate the studies that they claim to have replicated.

Looking at the papers side-by-side, it is apparent that Clark and co-authors used different species, life stages and ecological histories, and altered methods in critical ways that reduced the likelihood of detecting ocean acidification impacts on fish! Consequently, the claim that research by leading marine scientists such as Professor Munday and dozens of highly regarded research labs could not be replicated is completely unfounded and borders on the ridiculous.

Clark and co-authors also ignored a sizable scientific literature which suggests the exact opposite. According to a response from Professor Munday and a long list of colleagues

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(in press in the prestigious journal are Nature), there are over 80 peer-reviewed papers, by more than 50 different lead authors with over 180 co-authors from more than 90 institutions who report statistically significant effects of elevated $CO_2$ and ocean acidification on fish behaviour. Given this, you would have to conclude that the finding that elevated $CO_2$ and ocean acidification can affect fish behaviour has been replicated many times.

To conclude, there are two main take home points:

(1) The first is that difference between the results of two research groups is not a case of Clark being right and Munday and colleagues being "*wrong, 100 per cent"* (as proclaimed by Senator Roberts) but rather that the scientific process is working as it should (see above);

(2) A Senator who claims the scientific process is corrupted, yet decides – of two opposing papers – to say that the paper rejecting an argument he doesn't like is the 'good' one (without any further evidence) and the other is 'bad', displays a profound ignorance of the extensive work of Munday and many other research groups. This type of bias illustrates a profound ignorance of the scientific process, as well as a worrying disregard for Senate inquiries that should be solely directed at the objective search for evidence and truth.

I would be happy to discuss this matter further if need be.

Sincerely,

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Deputy Director, ARC Centre for Excellence in Coral Reef Studies