FORWARD

This pdf file attempts to capture elements of a debate concerning ocean pH that began to receive public attention from 2014 through 2016. Since that time, many of the elements have been inexplicably removed from the internet. For transparency and reproducibility, I've attempted to recapture key portions of that debate, including some aspects which can still be found and some which can no longer be found online.

ITEM 1 ***On 3 March, 2017, Michael Wallace has copied this content from***

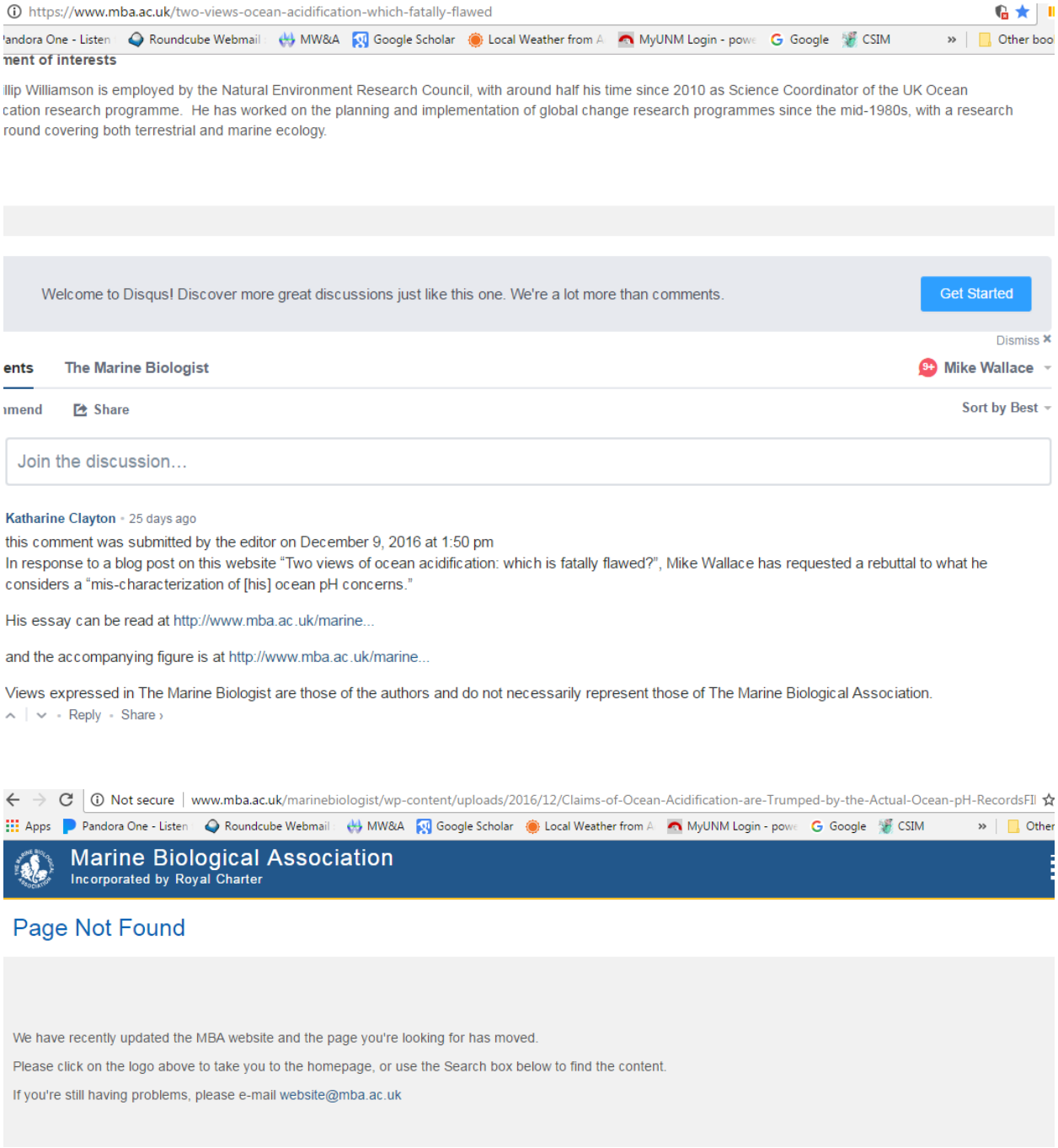
https://www.mba.ac.uk/two-views-ocean-acidification-which-fatally-flawed

in anticipation of the link being permanently removed by the associated Journal.

First a set of beginning and ending screen captures:

The first image points to an article in The Marine Biologist which publicly challenges work by Michael Wallace regarding ocean pH data

Second, two closing screen captures. The top documents that The Marine Biologist once had published a rebuttal by Michael Wallace. The bottom documents that the Journal has removed this rebuttal (as of 3 March 2017)



Next, the original article by Dr. Williamson. This article has not been removed even though the rebuttal was.

Phil Williamson responds to "Ocean acidification: yet another wobbly pillar of climate alarmism" by James Delingpole, published in *The Spectator* 30 April 2016

Citation: Williamson, P. (2016) *Two views of ocean acidification: which is fatally flawed?* [online] Plymouth, The Marine Biological Association, www.mba.ac.uk/marinebiologist/comments-on-ocean-acidification-yet-another-wobbly-pillar-of-climate-alarmism-by-james-delingpole/ [Accessed 23 Aug 2016]

Original article online at: http://www.spectator.co.uk/2016/04/ocean-acidification-yet-another-wobbly-pillar-of-climate-alarmism/

Summary

James Delingpole considers that ocean acidification is a scare story that is not only 'fatally flawed' but also grossly over-hyped by climate alarmists, for political reasons. To give credibility to these views, information and quotes are given from four scientists (Patrick Moore, Mike Wallace, Matt Ridley and Craig Idso). However, those sources are unreliable: none has relevant marine expertise, and the evidence they provide is either inaccurate or incorrect. Three other scientists (Howard Browman, Richard Feely and Christopher Sabine) who do have direct research experience are either mis-quoted or their competence is dismissed. The wider scientific literature is not considered. Overall, Delingpole's arguments are based on exaggeration, false dichotomy, deliberate selectivity and bravado assertion: almost everything that could be factually wrong, is wrong. Specific errors, with other comments, are identified below for each paragraph of the original text. Example references are also given, as links; many other supporting sources could also be cited.

Detailed comments

Delingpole's article text given first, in italics, followed by Williamson's comments. Paragraph numbering added by Williamson. Links within Delingpole text were not originally included, but have been added where the specific references are unambiguous.

1. [Article] There was a breathtakingly beautiful BBC series on the Great Barrier Reef recently which my son pronounced himself almost too depressed to watch. 'What's the point?' said Boy. 'By the time I get to Australia to see it the whole bloody lot will have dissolved.'

[Comments] Concern regarding the future of the Great Barrier Reef is fully justified – but not because the corals will soon dissolve. Instead, bleaching (loss of algae from the coral) is the most important current threat, due to unusually high seawater temperatures. Satellite surveys and field observations by the Australian government and independent researchers indicated that 20-50% (and locally up to 90%) of northern areas of the reef was affected by bleachingin late 2015/early 2016. Individual corals may recover from bleaching if high temperature events are short-lived; however, if the bleaching is permanent, the corals die. Population recovery, through re-colonisation and re-growth, typically takes 10-15 years.

2. The menace Boy was describing is 'ocean acidification'. It's no wonder he should find it worrying, for it has been assiduously promoted by environmentalists for more than a decade now as 'global warming's evil twin'. Last year, no fewer than 600 academic papers were published on the subject, so it must be serious, right?

Whilst the dead skeletons of coldwater corals (occurring in deep water, including around the UK) are at increasing risk of dissolving, a key effect of ocean acidification on warm-water corals is slower growth. Current growth rates are around 10% lower than they were before human activities increased atmospheric carbon dioxide, and reef development ceases at pH below 7.7, the projected end of the century level for high emission scenarios. Before then, it is near-certain there will be more frequent bleaching, due to further warming, together with even slower re-growth and population recovery due to ocean acidification. The cumulative effects of temperature change, ocean acidification and other stressors jeopardises the longterm survival of coral reef structures. The socio-economic consequences of reef loss are substantive, relating to coastal protection and fisheries, as well as tourism.

The scientific literature on ocean acidification covers much more than effects on corals. Collectively it provides the factual evidence that enables the seriousness of ocean acidification to be dispassionately assessed; for example, by the Intergovernmental Panel on Climate Changeand the Convention on Biological Diversity.

3. First referenced in a peer-reviewed study in Nature in 2003, it has since been endorsed by scientists from numerous learned institutions including the Royal Society, the National Oceanic and Atmospheric

Administration and the IPCC. Even the great David Attenborough — presenter of the Great Barrier Reef series — has vouched for its authenticity: 'If the temperature rises up by two degrees and the acidity by a measurable amount, lots of species of coral will die out. Quite what happens then is anybody's guess. But it won't be good.'

More than 150 scientific articles on ocean acidification were published before 2003. Between 1989 and 2003, these averaged 9 per year, including geological, chemical and biological studies. The 2003 *Nature* study did, however, stimulate wider scientific and political interest in the topic area.

'Endorsed' implies approval (for ocean acidification). It would seem more appropriate to say that many scientists and institutions have recognised that ocean acidification is occurring, is an issue of concern, and is worthy of detailed investigation.

4. No indeed. Ocean acidification is the terrifying threat whereby all that man-made CO2 we've been pumping into the atmosphere may react with the sea to form a sort of giant acid bath. First it will kill off all the calcified marine life, such as shellfish, corals and plankton. Then it will destroy all the species that depend on it — causing an almighty mass extinction which will wipe out the fishing industry and turn our oceans into a barren zone of death.

What is the source of these statements? They have not been made by scientists studying ocean acidification, nor (as far as I am aware) by environmental NGOs. But maybe by sensation-seeking journalists? Or are they satirical exaggerations by Delingpole? If – as it seems – they are deliberate mis-representations for polemic effect, the 'climate alarmism' of the title is spurious. The rest of the article then has questionable credibility, whilst becoming logically fallacious.

5. Or so runs the scaremongering theory. The reality may be rather more prosaic. Ocean acidification — the evidence increasingly suggests — is a trivial, misleadingly named, and not remotely worrying phenomenon which has been hyped up beyond all measure for political, ideological and financial reasons.

The alternative to 'scaremongering theory' is not to dismiss ocean acidification as nothing at all to worry about. That assertion is equally incorrect, providing a false dichotomy – that is *not* increasingly supported by factual evidence, as discussed below.

6. Some of us have suspected this for some time. According to Patrick Moore, a co-founder of Greenpeace, long one of ocean acidification theory's fiercest critics, the term is 'just short of propaganda'. The pH of the world's oceans ranges between 7.5 and 8.3 — well above the acid zone (which starts below 'neutral' pH7) — so more correctly it should be stated that the seas are becoming slightly less alkaline. 'Acid' was chosen, Moore believes, because it has 'strong negative connotations for most people'.

Patrick Moore's linkage with Greenpeace is controversial: the organisation does not recognise him as a co-founder although Moore continues to make that claim. What is indisputable is that Moore has only very limited, if any, expertise in marine science.

The term ocean acidification is scientifically correct: it is used for technical reasons, not for any connotations it might or might not have for non-scientists. Thus 'acidification' is the process of decreasing pH (increasing acidity), wherever on the pH scale that occurs. In the same way, 'warming' is the process of increasing temperature, wherever that occurs – including rather cold parts of the world, e.g. polar regions.

The range of pH naturally occurring in the ocean is much wider than stated. Values as low as pH 5.4 – undoubtedly acid – have been recorded at deep sea vents (that do support life, adapted to such conditions).

7. Matt Ridley, too, has been scathing on the topic. In The Rational Optimist he wrote, 'Ocean acidification looks suspiciously like a back-up plan by the environmental pressure groups in case the climate fails to warm.' I agree. That's why I like to call it the alarmists' Siegfried Line — their last redoubt should it prove, as looks increasingly to be the case, that the man-made global warming theory is a busted flush.

Matt Ridley also has only limited, if any, expertise in marine science. An opinion article he wrote in The Times in 2010 on ocean acidification contained many errors. What he shares with Moore (and Delingpole) is climate scepticism, with an unscientific approach to evidence evaluation.

The sceptical view that man-made global warming is a 'busted flush' does *not* look increasingly to be the case; instead it is increasingly hard to challenge in a rational way the accumulating evidence of human influence on the climate. In addition to the extremely thorough IPCC analyses of such issues, recent climate record-breaking is incontestable. For example: 2015 was the warmest year on record (mean surface temperature 1^0C higher than in pre-industrial times), and that year included the lowest ever winter ice cover in the Arctic. 2016

is on course to beat those records – all months so far have been seasonally warmer than ever beforewith July 2016 being the hottest single month. Whilst there has been a significant contribution from the 2015-16 El Niño, that ended earlier this year – and the increase in total ocean heat content has been inexorable since 1970.

8. To the alarmist camp, of course, this is yet further evidence that 'deniers' are heartless, anti-scientific conspiracy theorists who don't read peer-reviewed papers and couldn't give a toss if the world's marine life is dissolved in a pool of acid due to man's selfishness and greed. Unfortunately for the doom-mongers, we sceptics have just received some heavy fire-support from a neutral authority.

Who exactly is the 'alarmist camp'? The failure to identify the source of these assertions is telling. If, as seems likely, they are imaginary and provided for rhetorical purposes, Delingpole is a double extremist – arguing against himself.

9. Howard Browman, a marine scientist for 35 years, has published a review in the ICES Journal of Marine Science of all the papers published on the subject. His verdict could hardly be more damning. The methodology used by the studies was often flawed; contrary studies suggesting that ocean acidification wasn't a threat had sometimes had difficulty finding a publisher. There was, he said, an 'inherent bias' in scientific journals which predisposed them to publish 'doom and gloom stories'.

Browman's articledoes not claim to be a 'review of all the papers published on the subject'; it is an Introduction to a Special Issue. Has Delingpole read it, or just the imbalanced and inaccurate accounts of it that were in the media (e.g. The Times, 1 March 2016), as challenged by Browman?

The words 'flawed', 'inherent bias' and 'doom and gloom' do not appear in Browman's article. Whilst its text does state "studies that report no effect of OA [ocean acidification] are typically more difficult to publish", those words are preceded by a crucial qualifier: "As is true across all of science".

Furthermore, Browman *does* consider ocean acidification to be a serious problem, warranting research attention: "Although I call for a more sceptical scrutiny and balanced interpretation of the body of research on OA, it must be emphasized that OA is happening and it will have effects on some marine organisms and ecosystem processes."

10. Ocean acidification theory appears to have been fatally flawed almost from the start. In 2004, two NOAA scientists, Richard Feely and Christopher Sabine, produced a chart showing a strong correlation between rising atmospheric CO2 levels and falling oceanic pH levels. But then, just over a year ago, Mike Wallace, a hydrologist with 30 years' experience, noticed while researching his PhD that they had omitted some key information. Their chart only started in 1988 but, as Wallace knew, there were records dating back to at least 100 years before. So why had they ignored the real-world evidence in favour of computer-modelled projections?

The 'Feeley and Sabine chart' criticised by Wallace was not included in their seminal 2004 paper, but was first published in 2008 (authorship Richard Feely, Victoria Fabry and John Guinotte, giving data credit to Pieter Tans and David Karl). Mike Wallace's hydrological expertise is in groundwater pollution, particularly minewater management. He has not published any peer-reviewed papers on ocean acidification, nor marine chemistry. By contrast, Richard Feely and Christopher Sabine are both oceanographers; their combined total is around 70 years of relevant experience, with around 500 relevant publications.

There are three very good reasons, all relating to data quality, why the additional pH measurements identified by Wallace have not been included in NOAA-led analyses. First, the sensors used until around 1988 were not sufficiently precise to reliably detect changes of ~0.002 pH units per year; second, associated information on sensor calibration was lacking; and third, there was uncertainty whether or not temperature corrections had been made.

Furthermore, measurements of many other environmental factors (and considerable statistical skill) are needed to determine a 'global average' in ocean pH from a limited number of water samples randomly collected at different times of year from different places at different water depths. The importance of other factors affecting ocean acidification data has only recently been recognised, thereby enabling data to be combined from different sources.

11. When Wallace plotted a chart of his own, incorporating all the available data, covering the period from 1910 to the present, his results were surprising: there has been no reduction in oceanic pH levels in the last -century.

Wallace's chart does not show any significant trend in global pH because the data he used are not appropriate for such analysis, for the reasons given above. It is a scientific impossibility for global pH to have changed as shown on Wallace's chart: from below 7.8 in the 1920s to nearly 8.4 by 1940, and then back to 7.8 by 1960. There are, however, very thorough, peer-reviewed studies that identify the location-specific decrease of pH in near-surface waters since 1990, as collated by the World Meteorological Organisation.

12. Even if the oceans were 'acidifying', though, it wouldn't be a disaster for a number of reasons — as recently outlined in a paper by Patrick Moore for the Frontier Centre for Public Policy. First, marine species that calcify have survived through millions of years when CO2 was at much higher levels; second, they are more than capable of adapting — even in the short term — to environmental change; third, seawater has a large buffering capacity which prevents dramatic shifts in pH; fourth, if oceans do become warmer due to 'climate change', the effect will be for them to 'outgas' CO2, not absorb more of it.

Moore's FCPP paper has not been subject to expert scrutiny. If it had been, its scientific naivety and 'cherry-picking' approach would have precluded its publication in a reputable journal. The four conclusions re-presented by Delingpole are either incorrect or only partly true. Whilst a full response is not appropriate here, the fact that *some* marine species (with either short generation times or high fecundity) may be able to adapt to environmental change does not mean that *all* can. Thus there is high risk that 'nuisance' species (e.g. jellyfish) are those that will be favoured in future.

It is indisputable that many species of seafloor calcifiers became extinct at previous times of naturally-high CO_2, with much slower rate of atmospheric change. Yes, ocean buffering is a real effect – but it takes tens of thousands of years, whereas current ocean acidification is occurring on a decadal to century timescale. With regard to the interaction of warming and ocean acidification, the temperature change in CO_2 solubility is fully taken account of in ocean geochemical models: the only circumstances where net global ocean uptake would change to net global out-gassing would involve 'negative emissions' of CO_2, requiring the large net removal of the gas from the atmosphere.

13. Finally, and perhaps most damningly, Moore quotes a killer analysis conducted by Craig Idso of all the studies which have been done on the effects of reduced pH levels on marine life. The impact on calcification, metabolism, growth, fertility and survival of calcifying marine species when pH is lowered up to 0.3 units (beyond what is considered a plausible reduction this century) is beneficial, not damaging. Marine life has nothing whatsoever to fear from ocean acidification.

Idso's 'killer analysis' is online, as an 'Ocean Acidification Database' without named authorship. What is killed is any remaining scientific credibility. There are three crucial flaws in the information provided. First, taking the presented data at face value, positive effects for winning species do not cancel out negative effects for losers. Instead, ecological disruption will result from effects on food-webs and competitive interactions. An economic analogy can be made: if a change in government policy results in a third of the working population doubling their income, but two-thirds halving their income, the overall effect is not 'no change' – even though average income is unaffected.

Second, increased metabolism is not a 'benefit' but a stress response, equivalent to raised temperature during human illness. Greater food intake (that may not necessarily be possible) is required for increased metabolism to be sustained, with reduced longterm chances of survival by diverting energy from reproduction to other metabolic processes. Third, the statistical analyses are invalid, being based on linear rather than proportional scaling.

Combining results from different studies has to be done with great care. Nevertheless, such meta-analyses have been properly carried out for ocean acidification, for example those by Kroeker *et al.* and Wittman & Pörtner. Those syntheses are relatively easy to find, being frequently cited (unlike Idso's) by others. However, the meta-analyses carried out by ocean acidification experts do take account of taxonomic differences in responses, and reach very different conclusions from those given by Moore. Why were those additional analyses not mentioned by Delingpole? Such omission of evidence either demonstrates ignorance, or wilful distortion, with the latter being a much more serious form of bias than the publication issues discussed by Browman.

It is incorrect to say that a pH reduction of 0.3 units is beyond what is considered a plausible reduction this century: a slightly greater decrease, of 0.35, is projected to result from IPCC's 'business as usual' scenario (RCP 8.6) for the surface ocean. Whilst it is very much hoped that scenario will not be realised, its avoidance will need emission reductions and de-carbonisation (actions considered unnecessary by Delingpole, see below).

14. Given all this, you might well ask why our learned institutions, government departments and media outlets have put so much effort into pretending otherwise. Why, between 2009 and 2014, did Defra spend a whopping £12.5 million on an ocean acidification research programme when the issue could have been resolved, for next to nothing, after a few hours' basic research?

The £12.5 million funding for the UK Ocean Acidification research programme (UKOA) was mostly provided by the Natural Environment Research Council. Defra's co-support was around £1 million, with a similar contribution from the Department of Energy & Climate Change (DECC, now the Department for Business, Enterprise and Industrial Strategy).

The descriptor 'whopping' and the disparaging comments on the (un)importance of UKOA outputs do not reflect the range and impacts of the new knowledge that has been delivered. The programme involved experimental and modelling studies; fieldwork in UK and European seas, the Arctic Ocean and the Southern Ocean; analyses of the impacts of a natural ocean acidification event 56 million years ago; and partnerships with stakeholders and international colleagues. UKOA has already resulted in over 250 peer-reviewed publications, and has had policy influence at UK, European and UN levels.

UKOA's total spend over five years was much the same as the amount currently spent every two hours by the Ministry of Defence, or the cost of a top-of-the-range flat in central London, or a 16 m length of the proposed Crossrail 2; it was less than half the amount spent every year on research and partnerships by Coca Cola.

15. To those of us who have been studying the global warming scare in some detail, the answer is depressingly obvious. It's because in the last decade or so, the climate change industry has become so vast and all encompassing, employing so many people, it simply cannot be allowed to fail.

16. According to a report last year by Climate Change Business Journal, it's now worth an astonishing $1.5 trillion — about the same as the online shopping industry. If the scare goes away, then all bets are off, because the entire global decarbonisation business relies on it. The wind parks, the carbon sequestration projects, the solar farms, the biomass plantations — none of these green schemes make any kind of commercial sense unless you buy into the theory that anthropogenic CO2 is catastrophically warming the planet and that radical green measures, enforced by governmental regulation, must be adopted to avert it.

The quoted cost of the 'climate change industry' includes the global effort directed at improving the efficiency of energy, transport and buildings, as well as actions more explicitly related to climate change (e.g. climate-related insurance).

In considering 'commercial sense', the comparison to the online shopping industry seems irrelevant. More appropriate comparisons would be either to the $5.3 trillion pa currently spent in global energy subsidies, primarily in support of fossil fuel industry, or to the longterm cost of inaction. Estimates of the latter vary according to the discounting rate applied; using public-sector discounting, assets at risk are valued at $43 trillion – without any valuation of non-market environmental services.

17. It's no coincidence that the ocean acidification narrative began in the early 2000s — just as it was beginning to dawn on the climate alarmists that global temperatures weren't going to plan. While CO2 levels were continuing to rise, temperatures weren't. Hence the need for a fallback position — an environmental theory which would justify the massively expensive and disruptive ongoing decarbonisation programme so assiduously championed by politicians, scientists, green campaigners and anyone making money out of the renewables business. Ocean acidification fitted the bill perfectly.

The increased attention given to ocean acidification in the early 2000s by scientists, funding agencies and governments was for scientific reasons, relating to measurements and studies carried out in the 1990s. It was then recognised that ocean acidification posed an additional, previously neglected, risk arising from increasing atmospheric CO_2. Furthermore, ocean acidification was already having significant economic consequences for the US aquaculture industry. The conspiratorial linkages surmised by Delingpole are imaginary.

18. Does this prove that global warming is not a problem? No it doesn't. What it does do is lend credence to something we much-maligned sceptics have long been saying: that in many environmental fields, the science is being abused and distorted to promote a political and financial agenda. Perhaps it's about time our supposed 'conspiracy theories' were taken more seriously.

There undoubtedly has been inappropriate manipulation of science to promote specific agendas. But by whom? On the basis of the incomplete and incorrect information presented by Delingpole, his own article

provides much more impressive evidence for scientific abuse and distortion than anything communicated by ocean acidification researchers.

Statement of interests

Dr Phillip Williamson is employed by the Natural Environment Research Council, with around half his time since 2010 as Science Coordinator of the UK Ocean Acidification research programme. He has worked on the planning and implementation of global change research programmes since the mid-1980s, with a research background covering both terrestrial and marine ecology.

End of Article

ITEM 2. ***Next, the original rebuttal Michael Wallace had published in The Marine Biologist, which has since been removed from their site:***

Claims of Ocean Acidification are Trumped by the Actual Ocean pH Records

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This essay is written in response to a recent opinion piece authored by Dr. Phil Williamson in the August 23, 2016 edition of the Marine Biologist Journal (MBJ) titled "Two views of ocean acidification: which is fatally flawed?"[1].

In that piece, Dr. Williamson critiqued my work in part and relied upon other blog posts to support his concerns. I asked for this rebuttal opportunity and also reached out to Phil, who responded. In communicating with him, it appears to me now that we are not very far apart on practically anything to do with ocean pH and data. Yet I feel that a rebuttal is still an appropriate response, if only because of mutual background to Mr. Delingpole's related concerns [2].

To follow up, I am taking this rare opportunity to reassert that all of my reported concerns were valid and they have only grown so. Not long after my original FOIA resolution [3] and the X Prize Ocean Health announcement [4], NOAA scientists from the Pacific Marine and Environmental Laboratory (PMEL) issued a position paper [5] to somewhat clarify the previously undisclosed omission of nearly the entirety of ocean pH formal scientific records from most, if not all relevant ocean acidification research for the past several decades.

The authors of the release finally began to publicly share that their own widely accepted charts of ocean acidification over time were not based on any pH data prior to 1989[1]. Their position paper now equated those older pH records with an apparent deficiency that they attributed to allegedly

[1] As this essay now documents, their chart was not based on any ocean pH data at all.

poor precision of the measurements from that era. Although not mentioned in their paper, references [3] and [4] both primarily relate to those precision related questions.

Because of my academic research into global and regional hydroclimatologic systems, along with my continued professional work regarding acid mine drainage (AMD) in coastal settings, this missing data seemed a natural fit to my own interests. Over the past year I have attempted to publish much of what I have found to date regarding that missing data in comparison to more recent data and the questions of precision and modeling. It appears that there is no valid reason for the data to be omitted or replaced with PMEL - modeled data. Moreover, the simulated (modeled) data which replaced it did not match the high precision records that it was supposed to be aligned to. This is striking because the omitted low precision data actually does align to that, as well as to other independent climatological systems.

The data I explored is credible and interesting, but that is almost all that can be said of it by anyone so far (if only anyone would say something). I continue to learn and apply pH concepts myself. Just this month in a nano-synthesis class at the University of New Mexico it was reinforced to me that pH relates directly to surface energies of materials in contact with water, and those relationships are tied to electron orbitals according to the principles of quantum mechanics. For aqueous environments nothing appears to respond to electrons bouncing around more than free protons. The aqueous concentration of free protons (basically hydrogen ions) is nearly the classic definition of pH.

Through the Gibbs Free Energy pathways which continue to be mapped for most aqueous systems, these quantum state changes are what make pH so easy in some respects to simulate and to measure. For example, we often take a car battery for granted to power our vehicle over many

years. Throughout the past century, ocean researchers have utilized a variation of the battery to measure pH millions of times. This potentiometric cousin to the battery is commonly known as the glass electrode pH meter (geph). One is compelled to ask the obvious; did cars power up reliably prior to 1989 or not? If they did, it would be absurd to suggest that all geph measurements prior to 1989 were defective.

Many other metaphors are of possible interest, including that of a car odometer. No doubt odometers are now available that are far more precise than odometers which were installed in cars from the 1980s. Would this precision superiority now give any government scientist the license to reach back in time and prune all automobile records of older odometer readings? Would those scientists be further justified to replace all of those odometer readings with their own simulated narrative of your driving history? Would it be acceptable for them to carry this out without disclosure to you or to any other? Finally, would it be fine with constituents for them to base their undisclosed simulations upon nothing reproducible?

Many references are available for any to explore the further details of the state equilibria equations and empirical databases that once helped to define ocean pH. The current marine science consensus appears to depart from these established resources in order to assert the OA paradigm. This scenario is one in which Global Ocean pH (GOpH) persistently decreases over time, due overwhelmingly to control from the monotonically - increasing partial pressure of atmospheric CO2 [6]. This paradigm is reconstructed in the red curve and red square of Figure 1, which for convenience is referred to as the PMEL curve and its apparent sole calibration point [7].

Six open green circles in the figure document past and recent interpretations of Global Ocean Pelagic pH (GOPpH, the upper 200 m of the ocean), dating back to the 1950s. These six outside references are summarized in Table 1. Several decades of different viewpoints consider the relative impact of dissolved carbon dioxide gas (CO2) upon ocean pH. They appear to agree substantively on a representative mean global ocean pH value, ranging from 8.1 to 8.2.

Table 1. References for GOPpH values from peer reviewed and related literature entered as open circles in Figure 1 of this study.

REFERENCE	YEAR	GOPpH
Roger Revelle and Hans Suess, 1957 "Carbon Dioxide Exchange Between Atmosphere and Ocean and the Question of an Increase of Atmospheric CO2 during the Past Decades" Tellus IX (1957), 1	1957	8.18
R.M. Garrels and M.E. Thompson, 1962, "A chemical model for sea water at 25deg C and one atmosphere total pressure" American Journal of Science, Vol. 260, p. 57-66	1962	8.1
Goldberg, 1963, I. Chemistry 1. The Oceans as a Chemical System. In The Sea, Volume 2: The Composition of Sea-Water Comparative and Descriptive.. John Wiley and Sons, Inc.	1963	8.1
Kleypas, Joan A., R. W. Buddemeier, D. Archer, JP Gattuso, C. Langdon, and BN Opdyke, 1999, "Geochemical Consequences of Increased Atmonspheric Carbon Dioxide on coral Reefs", Science 2 april 1999, vol. 284 no 5411 pp. 118-120	1999	8.1
Royal Society, June 2005, "Ocean acidification due to increasing atmospheric carbon dioxide" Policy document 12/05 ISBN 0 8540 617 2 www.royalsoc.ac.uk	2005	8.2

Dickson A. G., Sabine C. L. & Christian J. R., 2007. Guide to best practices for ocean CO2 measurements. PICES Special Publication 3:1-191. Table 2 of Chapter 6.1	2007	8.1

The blue points and curves are products I developed from over 2 million data points which are archived at the NOAA NODC Ocean Climate Laboratory. This data appears to constitute the bulk of omitted GOPpH data, and is referred to here as the World Ocean Database (WOD) [8].

It was necessary for me to include the PMEL calibration point in the chart because the PMEL curve is not an actual time series based on data. Rather, as per the odometer metaphor, the PMEL curve is a model which has replaced decades of data [5] without prior disclosure. I recently contacted the PMEL authors to confirm the calibration point. I was surprised to learn from them that this calibration point is actually for another year, 2005 [7]. The actual high precision 1994 data, which the model was supposed to match to, is now represented by the open magenta circle. Accordingly this PMEL modeled curve does not fit to any historical data, not even to the high precision target data that it was supposed to emulate best. In contrast, the omitted low precision WOD data of 1994 appears to align with the accepted high precision data of 1994.

As I continue to see things, the majority of all historical instrumental ocean pH data were hidden from the public view so that an invalid account of ocean acidification could be asserted. This irreproducible assertion appears to have been embraced by an overwhelming consensus of practicing ocean scientists. Accordingly, the false claims have found acceptance within ever-

wider circles of our communities, leading to ever higher public anxiety and more misguided funding for ocean acidification research.

I think it would be a positive development if ocean science projects were funded by the promise of added practical knowledge rather than funded by fear. But there do not appear to be any ethics-based initiatives by the ocean science community to suggest that anything will change. For example, it has been 10 years since the irreproducible PMEL 2899 authoritative ocean acidification time series curve was published, but no practicing marine scientist to date has yet publicly challenged it.

For whatever it may be worth, my most recent time series investigations in this domain focus on a ten year moving average with supporting chemical equilibrium calculations. Within those studies, significance testing further suggests that the GOPpH time series has effectively no relation to the Mauna Loa atmospheric CO2 (MLCO2) series [9] and rather is more closely aligned to the Pacific Decadal Oscillation (PDO) [10].

Regardless of the likely continued reliance of some upon the false PMEL curve, it seems that the NOAA WOD records are beginning to receive growing interest. To me this seems like encouraging news. I often speculate myself on whether or not the century-scaled GOPpH record might have value in forecasting stream flow patterns in portions of the Himalayas and the Rockies [11].

Accordingly, The MATLAB code and method that I developed to more easily examine their database is available for free[2] to any researcher or educator from an email ending in ".edu" or ".org", or ".gov". Such researchers, students and others can now perhaps more quickly

[2] For a limited time to the remainder of the year 2016, email mwa@abeqas.com for details.

interrogate this dense and rich resource to develop their own explorations and understanding of past, present and future ocean measurements.

REFERENCES

[1] https://www.mba.ac.uk/marinebiologist/comments-on-ocean-acidification-yet-another-wobbly-pillar-of-climate-alarmism-by-james-delingpole/

[2] http://www.desmogblog.com/2016/08/26/director-uk-ocean-acidification-research-attacks-spectator-willfully-misleading-james-delingpole-column

[3] NOAA FOIA-2013-000883 & NOAA FOIA-2013-000884

[4] Wendy Schmidt Ocean Health X Prize est Fall 2013 http://oceanhealth.xprize.org/

[5] Pacific Marine Environmental Laboratory (PMEL) Fall 2013 estimated date http://www.pmel.noaa.gov/co2/story/Quality+of+pH+Measurements+in+the+NODC+Data+Archives

[6] Feely, R.A., C.L. Sabine, and V.J. Fabry, 2006, CARBON DIOXIDE AND OUR OCEAN LEGACY http://www.pmel.noaa.gov/pubs/PDF/feel2899/feel2899.pdf

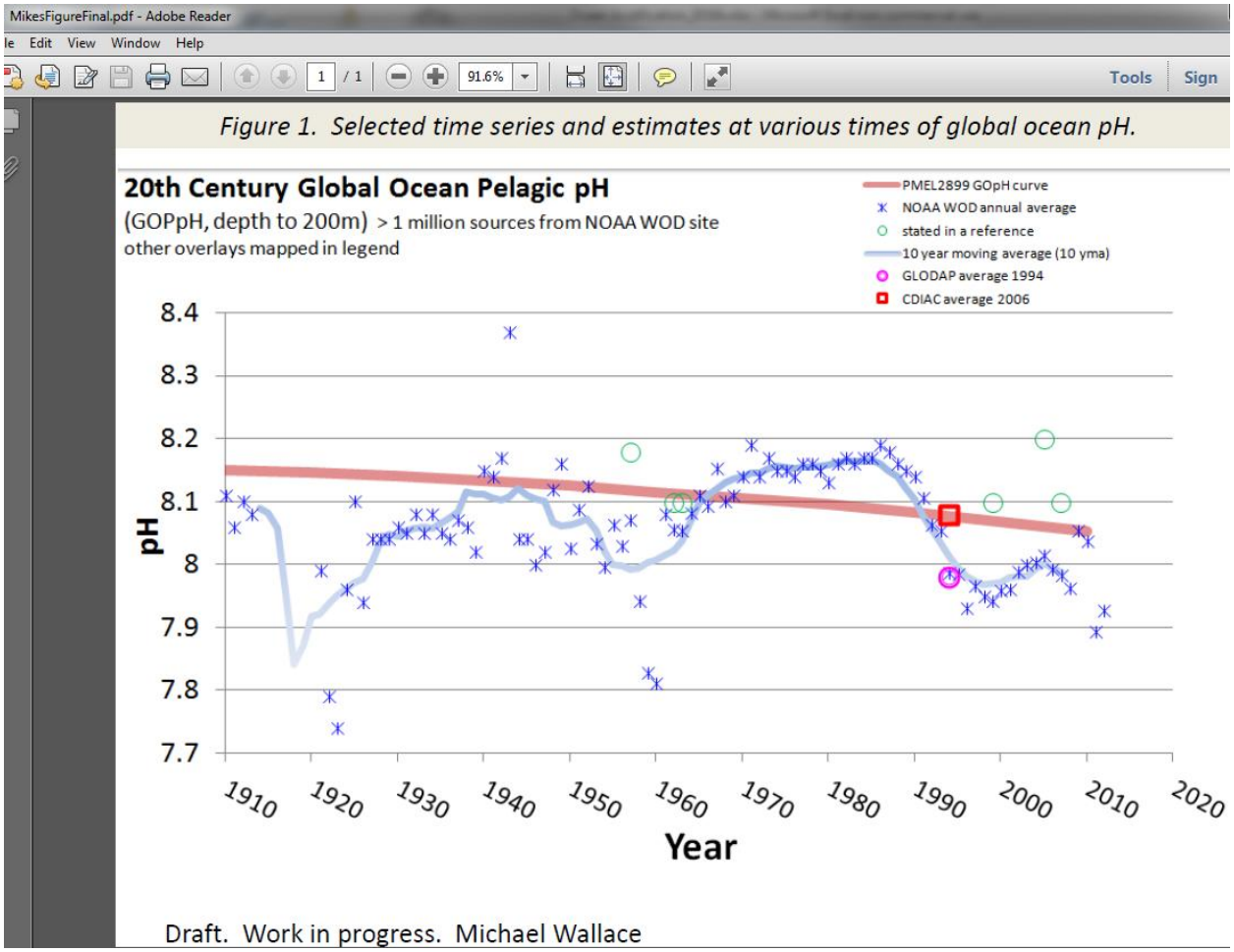
[7] GLODAP, CDIAC products at http://cdiac3.ornl.gov/waves/glodapv2/

[8] NOAA NODC http://www.nodc.noaa.gov/OCL/

[9] Wallace, M.G. 2016 draft paper posted now at https://www.academia.edu/26817206/A_DATA_BASED_TIME_SERIES_FOR_GLOBAL_OCEAN_PELAGIC_PH

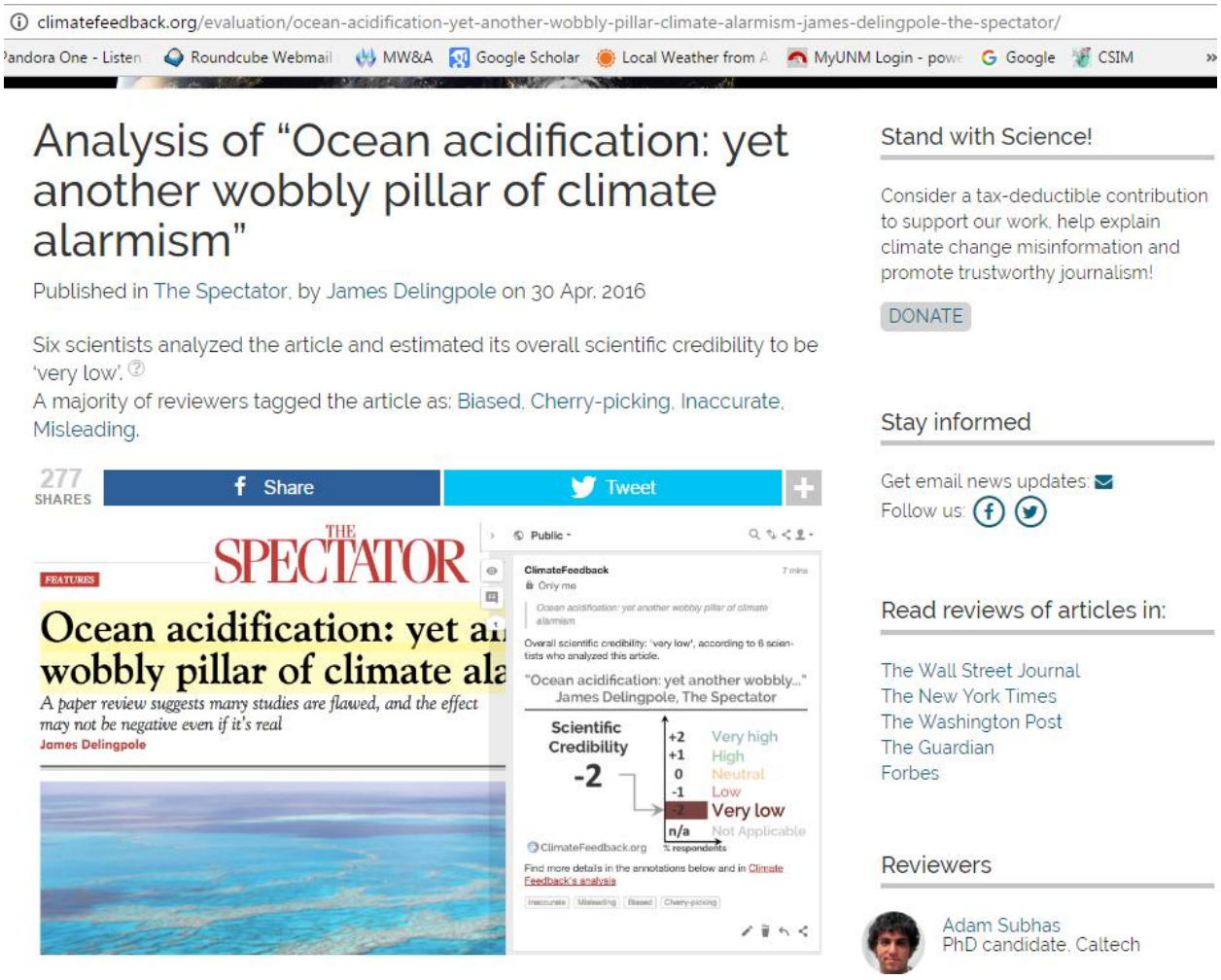
[10] Mantua, N.J. and S.R. Hare, 2002, The Pacific Decadal Oscillation. Journal of Oceanography, Vol. 58, pp. 35-44 2002

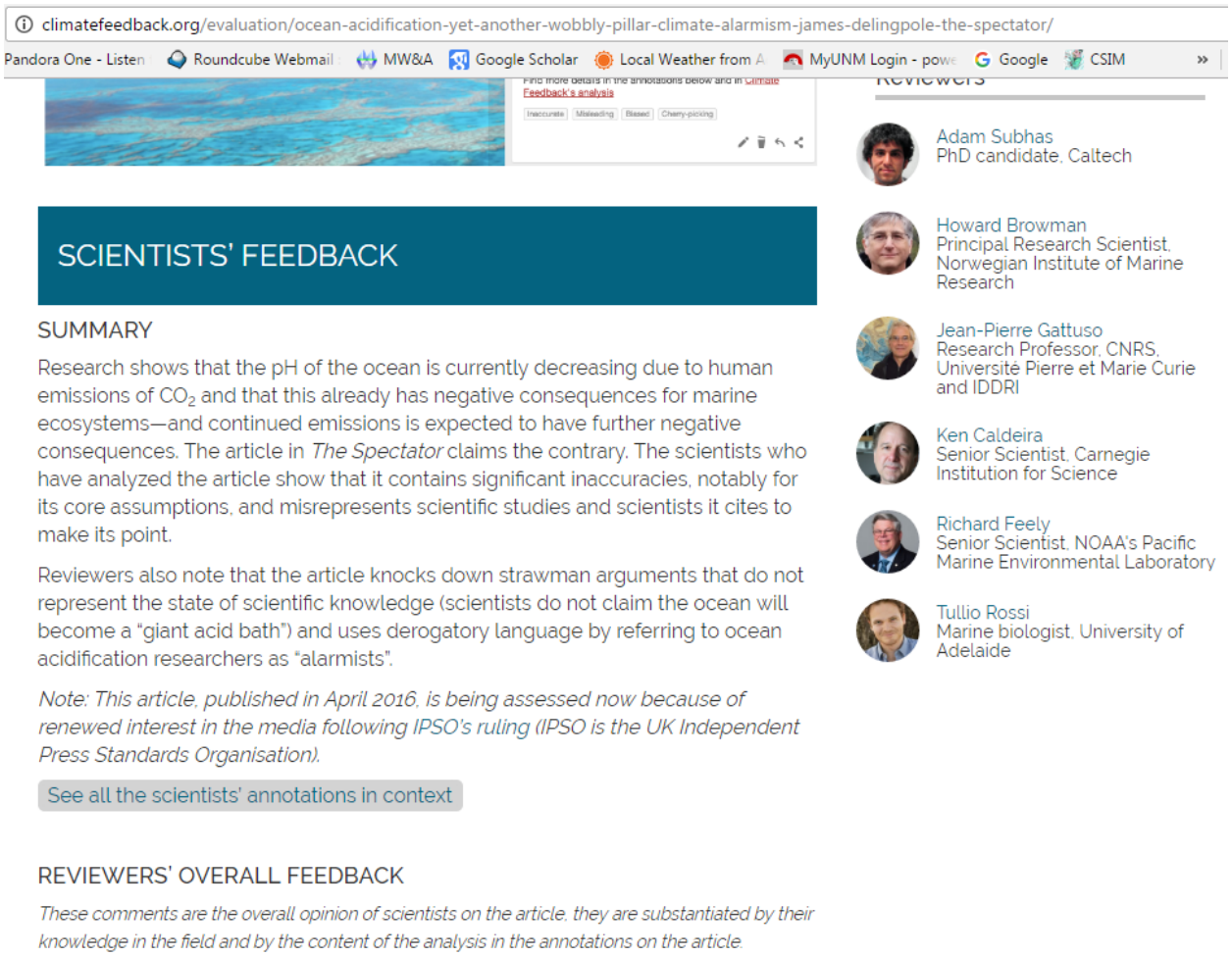
[11] http://www.abeqas.com/can-global-ocean-ph-anticipate-drought-in-the-western-us-8-years-in-advance/



ITEM 3. ***Next, recent (but undated) content authored by noted publicly funded ocean scientists, which links to the above and is directed against the work by Michael Wallace. A brief commentary by Wallace follows at the end.***

http://climatefeedback.org/evaluation/ocean-acidification-yet-another-wobbly-pillar-climate-alarmism-james-delingpole-the-spectator/





next the actual content:

SUMMARY

Research shows that the pH of the ocean is currently decreasing due to human emissions of CO_2 and that this already has negative consequences for marine ecosystems—and continued emissions is expected to have further negative consequences. The article in *The Spectator* claims the contrary. The scientists who have analyzed the article show that it contains significant inaccuracies, notably for its core assumptions, and misrepresents scientific studies and scientists it cites to make its point.

Reviewers also note that the article knocks down strawman arguments that do not represent the state of scientific knowledge (scientists do not claim the ocean will become a "giant acid bath") and uses derogatory language by referring to ocean acidification researchers as "alarmists".

Note: This article, published in April 2016, is being assessed now because of renewed interest in the media following IPSO's ruling (IPSO is the UK Independent Press Standards Organisation).

See all the scientists' annotations in context

REVIEWERS' OVERALL FEEDBACK

These comments are the overall opinion of scientists on the article, they are substantiated by their knowledge in the field and by the content of the analysis in the annotations on the article.

Howard Browman, Principal Research Scientist, Norwegian Institute of Marine Research:
As Phil Williamson has carefully documented, it is a story built upon selective back-grounding, based upon dubious sources, and presented in support of the author's own predetermined storyline and conclusion.

Adam Subhas, PhD candidate, Caltech:
This article bases its arguments on non-peer-reviewed publications and a study which uses poorly calibrated historical data. The article also oversimplifies the science behind ocean acidification in an attempt to trivialize well-understood chemical principles that predict how CO_2 dissolving into the ocean will affect ocean pH.

Ken Caldeira, Senior Scientist, Carnegie Institution for Science:
The chemistry of ocean acidification is well understood. Negative biological consequences have been documented for many marine organisms in a diverse set of carefully controlled experiments.
I was involved in an experiment in Australia's Great Barrier Reef where we added an 'antacid' to a plume of seawater, bringing seawater chemistry closer to what it was several hundred years ago. We let that water flow over a patch of reef and measured an increase in the growth rate of the reef. This showed that the increase in acidity caused by our CO_2 emissions is already slowing reef growth, harming the reef. Our measurements come out of sophisticated and carefully calibrated scientific instruments. They measure what is out there in the physical world, without any reference to our political views or our degree of alarm. Our measurements are not a matter of opinion.

Jean-Pierre Gattuso, Research Professor, CNRS, Université Pierre et Marie Curie and IDDRI:
This is an appalling article which distorts the scientific evidence by disqualifying thousands of peer-reviewed articles and highlighting only two un-peer-reviewed publications from non-expert authors.

Tullio Rossi, Marine biologist, University of Adelaide:
This is by far the most inaccurate article on ocean acidification I have ever seen. It is an explosive mix of false statements, cherry picking, and plain anti-science feelings.

Notes:
[1] See the rating guidelines used for article evaluations.
[2] Each evaluation is independent. Scientists' comments are all published at the same time.

KEY TAKE-AWAYS

The statements quoted below are from the article; comments and replies are from the reviewers.

1. The acidity of seawater has increased by about 30% over the industrial era due to the human-caused increase of atmospheric CO_2.

"*In 2004, two NOAA scientists, Richard Feely and Christopher Sabine, produced a chart showing a strong correlation between rising atmospheric CO_2 levels and falling oceanic pH levels. But then, just over a year ago, Mike Wallace, a hydrologist with 30 years' experience, noticed while researching his PhD that they had omitted some key information[…] his results were surprising: there has been no reduction in oceanic pH levels in the last -century.*"

Tullio Rossi, Marine biologist, University of Adelaide:
This is plain wrong. Oceanic pH levels decreased by 0.1 units compared to pre-industrial levels. This corresponds to a 30% increase in acidity. For a primer on pH, see this NOAA explainer.
Peer-reviewed references:

- Doney et al (2009) Ocean acidification: the other CO_2 problem, Annual Review of Marine Science
- Raven et al (2005) Ocean acidification due to increasing atmospheric carbon dioxide, The Royal Society

Ken Caldeira, Senior Scientist, Carnegie Institution for Science:
This statement just flies in both the face of observational facts and a basic understanding of chemistry. I would love to hear a cogent explanation of how atmospheric CO_2 levels could rise over the course of a century without producing a decrease in ocean pH.
Observations near Hawaii and several other open ocean environments show clear decreasing trends in ocean pH. See, for example this report from the European Environment Agency.
It is one thing to challenge future projections, but rejecting well-established scientific facts is another thing entirely.

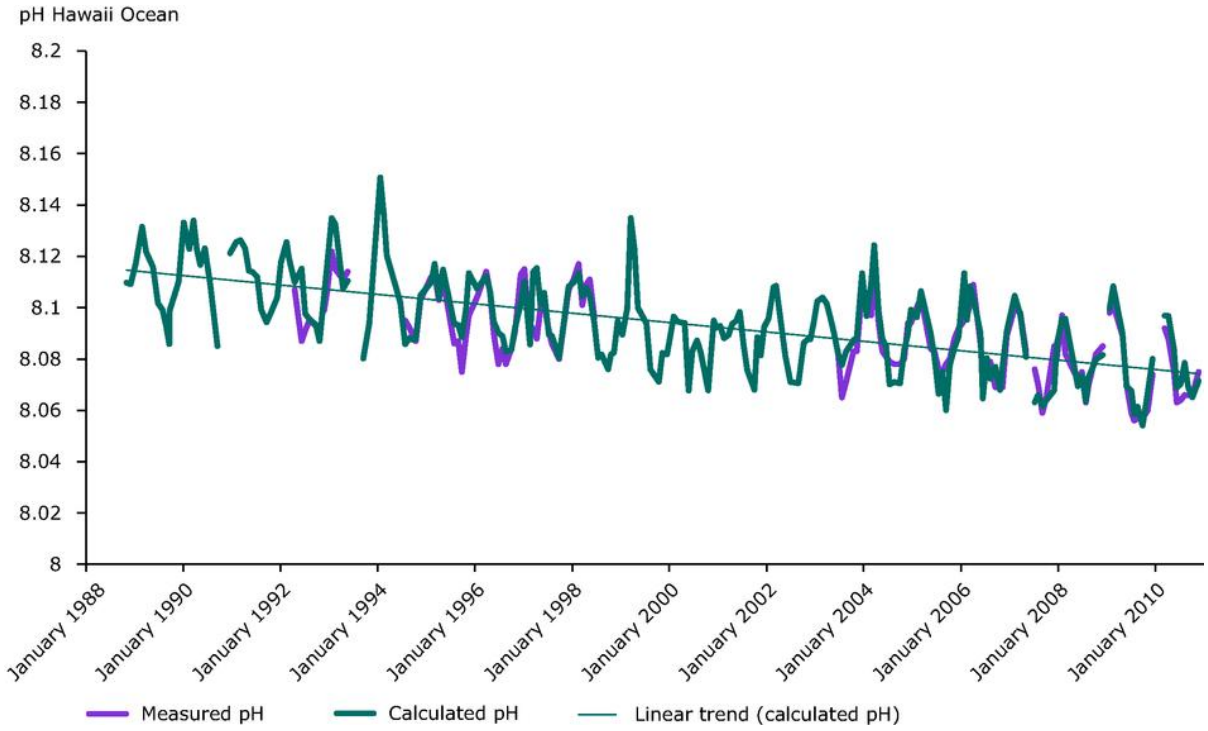


Figure: Decline in pH measured at the Aloha station as part of the Hawaii Ocean time-series. Source

Richard Feely, Senior Scientist, NOAA's Pacific Marine Environmental Laboratory:
Michael Wallace contacted Chris Sabine and myself several years ago and asked how to get access to historical pH measurements in the oceans so he could determine long-term trends of global ocean pH for himself. We directed him to both modern (as published in Feely et al., 2008) and historical pH measurements archived at the NOAA National Centers for Environmental

Information. We cautioned him that the earlier data sets prior to 1989 had significant issues with data quality as described in the document that went along with the data set obtained from NCEI. Mr. Wallace went on to perform his analysis of the historical data without regard for the oceanographic community's concerns about the data quality or for the proper methodology to perform this kind of analysis. He chose to publish his results within the context of an interview written by Marita Noon in the Farmington Daily Times. We responded by correcting the record by formally restating our concerns about Mr. Wallace's incorrect use of the historical data on our website. In short, Wallace's chart does not show any kind of useful trend in global ocean pH because the data he used, and the way he used them, were not appropriate for this kind of analysis. In the first place, the pH measurements prior to 1989 were not reliable enough to detect small pH changes over that period. In addition, companion meta data on sensor calibration, pH scales, and temperature corrections were not available. Finally, the data were so limited that no meaningful global averages could be determined. The article by Mr. Delingpole in *The Spectator* failed to address these important issues, as Philip Williamson correctly points out in his response to the article.

"Ocean acidification is the terrifying threat whereby all that man-made CO_2 we've been pumping into the atmosphere may react with the sea to form a sort of giant acid bath."

Jean-Pierre Gattuso, Research Professor, CNRS, Université Pierre et Marie Curie and IDDRI:
That is incorrect. No peer-reviewed article claim that the ocean will become acid (pH < 7).

"'Acid' was chosen, Moore believes, because it has 'strong negative connotations for most people'."

Tullio Rossi, Marine biologist, University of Adelaide:
The terms acidification was not chosen for its negative connotation but rather because it *defines the direction of change*. Here is a simple example: when you describe the cooling of your coffee what term do you use? Cooling or un-warming? If the temperature is going down we say it is cooling. If the temperature is going up we say it is warming. The same applies to acidity. When the pH of something goes down we say that it is acidifying. That simple.

"so more correctly it should be stated that the seas are becoming slightly less alkaline."

Adam Subhas, PhD candidate, Caltech:
This is actually not correct. Invasion of CO_2 into the ocean does not change its alkalinity at all. By adding carbonic acid, and keeping alkalinity constant (defined as either the difference between dissolved cations and anions, or the excess of acid-base species at the CO_2 equivalence point), the pH decreases.

"seawater has a large buffering capacity which prevents dramatic shifts in pH;"

Adam Subhas, PhD candidate, Caltech:
This is true; however, the amount of CO_2 emitted by humans is also massive, a large portion of which has already been absorbed by the oceans. Since pH is relatively insensitive to changes in CO_2, it is often not the right parameter to look at in the whole system. For example, over the range of pH values which the author states are found in natural seawater, the surface pCO_2 changes from 180 ppm (pH 8.3) to 1500 ppm (pH 7.5). Thus, a mean change in ocean pH of 0.3 pH units represents almost a tripling of seawater pCO_2.

2. Decreasing ocean pH is documented to pose significant risks to marine ecosystems, though the magnitude of the impacts depends on specific species.

"[…]The impact on calcification, metabolism, growth, fertility and survival of calcifying marine species when pH is lowered up to 0.3 units […] is beneficial, not damaging. Marine life has nothing whatsoever to fear from ocean acidification."

Ken Caldeira, Senior Scientist, Carnegie Institution for Science:
There is much evidence available to falsify this statement. Many experiments have shown substantial negative biological responses at these levels of pH change. Of course, some organisms are relatively unaffected by these levels.

An older review that is available here without a paywall:

- Langdon (2002) Review of experimental evidence for effects of CO2 on calcification of reef builders. In *Proc. 9th Int. Coral Reef Sym*.

"Then it will destroy all the species that depend on it — causing an almighty mass extinction which will wipe out the fishing industry and turn our oceans into a barren zone of death."

Jean-Pierre Gattuso, Research Professor, CNRS, Université Pierre et Marie Curie and IDDRI:
That is not a truthful summary of the scientific literature. Check, for example, the meta-analysis of Kroeker et al. (2013) who describe processes and organisms that do not seem to be affected by ocean acidification.

- Kroeker et al. (2013) Impacts of ocean acidification on marine organisms: quantifying sensitivities and interaction with warming. Global Change Biology.

"a killer analysis conducted by Craig Idso of all the studies which have been done on the effects of reduced pH levels on marine life."

Jean-Pierre Gattuso, Research Professor, CNRS, Université Pierre et Marie Curie and IDDRI:
This publication is not peer-reviewed, cherry-picks articles and does not involve proper statistical testing. It does not, therefore, qualify as a "killer analysis"! The comprehensive metanalysis that was performed by Kroeker et al. (2013) revealed decreased survival, calcification, growth, development and abundance in response to acidification when the broad range of marine organisms is pooled together. However, the magnitude of these responses varies among taxonomic groups.

- Kroeker et al (2013) Impacts of ocean acidification on marine organisms: quantifying sensitivities and interaction with warming. Global Change Biology.

Richard Feely, Senior Scientist, NOAA's Pacific Marine Environmental Laboratory:
The Idso meta-analysis described by Delingpole was never published. It does not take into

account the proper method of proportional scaling analysis. It does not demonstrate how negative effects will impact ecosystem services and food-web processes that can have an effect on economically important fish and shellfish. It does not address the impacts we are already seeing on important fish food, such as pteropods (see Bednarsek et al., 2012, 2014; Feely et al., 2016). There are several highly credible published meta-analysis studies (Kroeker et al. ,2013; Wittman & Pörtner, 2013; and Busch and McElhany, 2016) that have told a much different story than Idso's unpublished work. Delingpole failed to even mention these other studies, which show very significant impacts on several marine taxa. In summary, Delingpole's article demonstrates a complete lack of appreciation of scientific literature on this topic and the proper choice of scientific methods for data analysis and synthesis that leads to a more accurate understanding of the present-day and future impacts of ocean acidification.

- Bednaršek et al (2012) Extensive dissolution of live pteropods in the Southern Ocean, Nature Geoscience
- Bednaršek et al (2014) Limacina helicina shell dissolution as an indicator of declining habitat, Proc. of the Royal Society B
- Feely et al (2016) Chemical and biological impacts of ocean acidification along the west coast of North America, Estuarine, Coastal and Shelf Science

"First, marine species that calcify have survived through millions of years when CO_2 was at much higher levels; second, they are more than capable of adapting — even in the short term — to environmental change"

Ken Caldeira, Senior Scientist, Carnegie Institution for Science:
Many marine organisms respond to changes in calcium carbonate mineral saturation states. These depend not only on pH, but also on factors including amounts of carbon and calcium in the ocean. One of the most important factors is ocean alkalinity, which varies on time scale of many thousands of years. In the geologic past, when atmospheric CO_2 was high, ocean alkalinity was also high, and so carbonate mineral saturation states could remain high.

Unfortunately, on the timescale of centuries or decades, changes come too fast for the ocean's natural processes to buffer ocean carbonate mineral saturation states.

Directly comparing effects of high CO_2 levels that developed in the geologic past over many millions of years with high CO_2 levels developing today over decades and centuries shows a fundamental lack of understanding of well-established global geochemical cycles. This open access article explains some of the relevant chemistry:

- Cao et al (2016) Simulated effect of deep-sea sedimentation and terrestrial weathering on projections of ocean acidification, Journal of Geophysical Research Oceans

Jean-Pierre Gattuso, Research Professor, CNRS, Université Pierre et Marie Curie and IDDRI:
Some calcifying species were indeed abundant in the Cretaceous, a time at which the atmospheric CO_2 concentration was high. However, seawater alkalinity was also high due to intense weathering on land. Hence, the concentration of carbonate ions (CO_3, which controls calcification) was elevated. That compensation does not happen today and will not happen in the

near future because total alkalinity does not change significantly on time scales of centuries. There is ample evidence in the literature for that.

Some fast-growing species are indeed able to develop some level of adaptation after several hundreds of generation. Overall, there is evidence that all past episodes of ocean warming, acidification and deoxygenation have led to mass extinctions. Furthermore, there is no calcifier close to CO_2 vents, suggesting that adaptation has limited capabilities.

3. The article contains other inaccuracies and misrepresentations of its sources.

"if oceans do become warmer due to 'climate change', the effect will be for them to 'outgas' CO_2, not absorb more of it"

Jean-Pierre Gattuso, Research Professor, CNRS, Université Pierre et Marie Curie and IDDRI:
Incorrect: The effect of warming is completely overwhelmed by the effect of increased atmospheric CO_2. Hence, the ocean will continue to absorb massive amounts of CO_2 in the future, despite ocean warming.

"[ocean acidification was] First referenced in a peer-reviewed study in Nature in 2003"

Jean-Pierre Gattuso, Research Professor, CNRS, Université Pierre et Marie Curie and IDDRI:
The expression "ocean acidification" was actually introduced in 2001 by Broecker and Clark*. But the chemical processes involved have been know for a very long time at least the 1950s) and the impact of low pH (elevated acidity) on marine organisms since the early 1900s. The earliest experiments even predate the definition of pH by Sørensen in 1909.

- Broecker & Clark (2001) A dramatic Atlantic dissolution event at the onset of the last glaciation, Geochemistry Geophysics Geosystems

"Howard Browman, a marine scientist for 35 years, has published a review in the ICES Journal of Marine Science of all the papers published on the subject. His verdict could hardly be more damning. The methodology used by the studies was often flawed; contrary studies suggesting that ocean acidification wasn't a threat had sometimes had difficulty finding a publisher. There was, he said, an 'inherent bias' in scientific journals which predisposed them to publish 'doom and gloom stories'."

Howard Browman, Principal Research Scientist, Norwegian Institute of Marine Research:
The following decomposition of this excerpt from Mr. Delingpole's article in *The Spectator* identifies inaccuracies in his reporting that lead to misrepresentation of the content and intent of my article. Importantly, Mr. Delingpole never contacted me to verify that his reporting on my article was accurate. Nor was I contacted by the UK's Independent Press Standards Organisation during their investigation of the accuracy of Mr. Delingpole's article in *The Spectator*.

"*Howard Browman, a marine scientist for 35 years, has published a review in the ICES Journal of Marine Science of all the papers published on the subject.*"

Howard Browman, Principal Research Scientist, Norwegian Institute of Marine Research: The article that Mr. Delingpole is referring to is not "a review", but an introduction to a special theme issue on the topic of ocean acidification[…] The introduction does not review all of the nearly 4000 articles on the subject. Rather, it presents an overview of the sub-set of research dealing with biological/ecological effects of ocean acidification.

"*His verdict could hardly be more damning.*

Howard Browman, Principal Research Scientist, Norwegian Institute of Marine Research: On p. 530 of the introduction, I state: "Although I call for a more sceptical scrutiny and balanced interpretation of the body of research on OA [Ocean Acidification], it must be emphasized that OA is happening and it will have effects on some marine organisms and ecosystem processes." This is hardly a verdict that "…could hardly be more damning."

"*The methodology used by the studies was often flawed*"

Howard Browman, Principal Research Scientist, Norwegian Institute of Marine Research: My introduction does not present a quantitative assessment of the frequency of occurrence of methodological flaws in the ocean acidification literature.

"*There was, he said, an 'inherent bias' in scientific journals which predisposed them to publish 'doom and gloom stories'.*"

Howard Browman, Principal Research Scientist, Norwegian Institute of Marine Research: The words "inherent bias" do not appear in my article. Rather, I refer to "publication bias". In research, an "inherent bias" is one which is inextricably tied to the core nature of the phenomenon being studied and cannot, therefore, be eliminated by increasing the sample size or choosing a different estimator. "Publication bias", on the other hand, refers to the general (across all of science) phenomenon by which studies presenting positive results – supporting the hypothesis being tested – are more likely to be published than those reporting negative results. This sometimes creates a situation where published studies may be systematically different from unpublished studies – for example, studies showing an impact of ocean acidification might be published more easily and in higher profile journals than studies showing no impact. However, I only allude to this possibility in the introduction; I do not asses it quantitatively (something that would, in fact, be very difficult to do). Finally, the words "doom and gloom" do not appear in my introduction.

Commentary on* ITEM 3 *by Michael Wallace

The assertions captured in the Item 3 above by Adam Subhas, Howard Browman, Jean-Pierre Gattuso, Ken Caldiera, Richard Feely, and Tullio Rossi are not responsive to my rebuttal in **ITEM 2**. This highlights the fact that because my rebuttal has been removed from The Marine Biologist, there is no longer any opportunity for a fair and transparent debate.

Moreover, the statements by Richard Feely misrepresent my original communications with him and his colleague, Pacific Marine Environmental Laboratory (PMEL) Director Christopher Sabine. Accordingly to correct that record, I am including a full transcript of those communications in the final **ITEM 4.**

Also, Dr. Feely cites above a response he produced to my ITEM 4, ("We responded by correcting the record by formally restating our concerns about Mr. Wallace's incorrect use of the historical data on our website.") at this link:

http://www.pmel.noaa.gov/co2/story/Quality+of+pH+Measurements+in+the+NODC+Data+Archives\

However that link makes no mention of my role. Typically, regardless of the controversial nature of a contribution, the contributor is cited. Otherwise, plagiarism becomes an additional issue. Accordingly it would have been appropriate for Dr. Feely to cite me in that official NOAA page.

Also disregarded by these authors is the fact that over the year 2016, I have attempted to publish a paper for peer review along the lines of this draft at Academia.edu:

https://www.academia.edu/30317274/PROFILES_OF_A_DATA_BASED_TIME_SERIES_FOR_GLOBAL_OCEAN_PELAGIC_PH

A similar version of this paper was rejected by Dr. Browman, who appears to disregard that in his discussion above, as well as the Journal of Limnology and Oceanography and the Journal Geochemica et Cosmochimica acta. None of the rejections, including Dr. Browman's, included any technical reasons for dismissal. One rejection by the Journal of Limnology and Oceanography included a remarkably incorrect statement that the oceans were not buffered solutions as per official communication from Robert Howarth, Ph.D. Editor in Chief on September 24, 2016:

"the seawater is poorly buffered and its pH can change due to CO2 exchange with the atmosphere,.."

ITEM 4

This ITEM 4 is a relatively complete transcript of the original communications I had which are incorrectly characterized by Richard Feely and others above. The transcript is foundational to the resulting controversy.

http://www.abeqas.com/wp-content/uploads/2017/03/PMEL-Feely-Sabine-Wallace-Transcript-March-through-June-2013-Ocean-pH-acidification.pdf

Post Script

Any communications to verify this work and/or to re-open a transparent debate are most welcome. I believe that transparency is essential to a level playing field for all researchers and practitioners, especially when work is funded through public agencies.

Mike Wallace 3 March, 2017 www.abeqas.com