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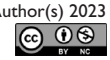
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Fuelling the climate and science 'denial machine' on social media: A case study of the Great Barrier Reef's 2021 'in danger' recommendation on Twitter, YouTube and Facebook

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Abstract

Australian climate policy has been stifled by a network of free-market and extractive industry-advocating actors, yet there is little empirical evidence to show how these actors and information flows behave in online communication spaces during Australian environmental conflicts. Focusing on the UNESCO 2021 'in danger' recommendation for the Great Barrier Reef for 6 weeks, this mixed-methods study of Twitter, Facebook and YouTube uses social network analysis, including cluster analysis and in-depth close reading. We find that a small, yet significant, mix of ideologically aligned partisan actors are fuelling the 'denial machine' in Australia by co-opting a scientific report's findings to argue that the Great Barrier Reef has recovered, and to contest the need for climate action. This article offers insights into the central actors and tactics that could erode public support for Australian climate policy, with similarities to strategies already established in the United States. It also contributes to furthering multi-platform analyses.

Keywords

Australian politics, climate change, environmental communications, Great Barrier Reef, media and science, multi-platform analysis, science communication, social media, social network analysis

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1. Introduction to denial machines

Communicating even small amounts of scientific uncertainty impacts an audience's likelihood to support environmental policy (Aklin and Urpelainen, 2014). This understanding has cemented 'manufacturing' scientific doubt and controversy as a tried and tested tactic enlisted by actors like free-market thinktanks, extractive industry, contrarian scientists, conservative media and politicians, alternative media/bloggers and lobby groups to derail policies they perceive as economically or ideologically damaging (Ceccarelli, 2011; Oreskes and Conway, 2010). These actors are part of a climate 'denial machine' (Dunlap and McCright, 2011: 144, following Begley, 2007), working to undermine climate-related regulation, even if their efforts are not explicitly coordinated and their claims and tactics differ. While this interplay is documented in the United States (Coan et al., 2021; Dunlap and Brulle, 2020; Ekberg et al., 2022), there is less empirical work mapping these interactions in social media networks within the Australian context during climate change discussions, particularly across multiple communications platforms (Pearce et al., 2019). It is important to understand these interplays in Australia given its history of 'climate wars' where a network of pro-fossil fuel and anti-regulation advocates have played a key role in delaying, weakening and repealing climate policy (Wilkinson, 2020).

Our research addresses this gap by studying an Australia-centric, yet globally relevant, mediatised environmental conflict event (Hutchins and Lester, 2015): UNESCO's 2021 recommendation to list the Great Barrier Reef as 'in danger'. Given the prominence of contemporary communication networks as key sites of knowledge formation, contestation and power (Castells, 2013), interactions were mapped across Twitter (now 'X'), YouTube and Facebook to understand the central actors in these discussions and what and how information was being furthered in online news-sharing spaces. We found that a scientific report about the Reef's health that was released in the lead up to the 'in danger' decision was reframed and co-opted by a small but significant group of conservative partisan actors to argue that the Reef had recovered, diminishing the need for climate-related action and policy. We find this is consistent with tactics deployed by an established 'denial machine' in the United States. We recognise that while this term may not convey how such tactics are varied and extend beyond outright denial (Ekberg et al., 2022; King et al., 2022), we continue to use this concept for consistency with extant literature, which does highlight differing strategies. It also serves to draw attention to similar actors who are behaving in mutually reinforcing ways typical of the 'denial machine', yet in an Australian context (Dunlap and McCright, 2011).

2. Australia's political and media context

Understanding the dynamics of climate change policy in Australia means appreciating the interdependent 'nexus' of the fossil fuel industry, politics and mainstream media (Holmes and Star, 2018). These assorted actors have served to sow uncertainty in climate science and inhibit the development of Australian climate policy (Chubb, 2012; Taylor, 2014; Wilkinson, 2020). The level of Australian government support for policies designed to offset the consequences of consumption has varied greatly in an environment that has been politically hostile (Macneil, 2021), with the conservative former Liberal–National coalition government criticised for its lack of action on climate change during its 9 years in power (Crowley, 2021). An Australian federal election in May 2022 saw this government change, with the left-leaning Australian Labor Party replacing the coalition. There was a large swing to the Australian Greens and climate-focused Independent candidates, and Australia has since seen its first dedicated Climate Change Bill (2022) passed. This change of government occurred after the data collection and analysis for this study.

While the outcome of the 2022 Australian federal election could point to a public desire for climate-related action and recent surveys show about 70% of Australians see climate change as a serious threat, around 20% still view it as a minor threat or problem (Park et al., 2020, 2022; Poushter et al., 2022). Furthermore, these levels of concern are linked to political orientation, with Park et al. (2022) finding 81% of left-leaning respondents were 'very' or 'extremely' concerned, versus 32% on the right (p. 17), while 91% on the left identified climate change as a major threat, compared with 47% right-leaners in Poushter et al. (p. 8). This left–right variation was second only to the United States. These results are consistent with research that links conservatism and climate scepticism more strongly in Australia and the United States than in 23 other countries (Hornsey et al., 2018; see also Tranter, 2020). There are also parallels with levels of climate change-related concern and media consumption, with audiences of conservative commercial radio (including 2GB, 2UE and 3AW) and News Corp-owned partisan right-wing broadcasters *Sky News Australia* and *Fox News* less likely to think climate change is serious than audiences of other mainstream news outlets (Park et al., 2020).

This interplay between politics, media use and climate attitudes signals a need to investigate popular news-sharing spaces for empirical evidence of a climate 'denial machine' in Australia. We address this knowledge gap through a conflict-inducing event that attracted widespread attention.

Case study: Great Barrier Reef 'in danger' recommendation

Situated on the east coast of Australia, the World Heritage-Listed Great Barrier Reef has been the subject of decades of conflict over its health and the politics of its protection (Foxwell-Norton and Konkes, 2018). Climate change is the biggest threat to the Reef, with the Australian government's management agency warning that immediate CO_2-limiting action is needed to slow the deterioration of natural and cultural values (Great Barrier Reef Marine Park Authority (GBRMPA), 2019). In June and July 2021, the Reef attracted international attention in online and offline news-sharing spaces when it was threatened with an 'in danger' listing by UNESCO,[1] ahead of the 44th World Heritage Committee (WHC) session. However, while the Reef's declining health is well documented (GBRMPA, 2019), some Australian political leaders were 'blindsided' by the recommendation, saying politics were at play (Department of Agriculture, Water and the Environment (DAWE), 2021a; Day et al, 2021). The outcome at the 23 July 2021 WHC meeting was to postpone the 'in danger' decision for another year, with Australia required to provide an update on its protection efforts by February 2022, ahead of a committee meeting scheduled for later that year.[2]

In the same week that the WHC made its decision, the Australian Institute of Marine Science (AIMS) released its *Annual Summary Report of Coral Reef Condition 2020/2021* (hereafter: 'coral cover report'). Accompanying the report's publication were two media releases: one from then-Australian Environment Minister Sussan Ley, and another from AIMS itself. The messages of these media releases are broadly consistent, saying that coral recovery across the Reef had been widespread due to a respite from severe weather events. The Minister's release, however, highlights the Reef's adaptability and ability to recover (DAWE, 2021b). The AIMS version, in contrast, notes the limits to the Reef's resilience and describes a 'recovery window' largely driven by a coral species that was 'fast to grow', but 'often the first to go' (AIMS, 2021).[3] A few months after the report's release, investigations showed the Minister's Office had directed AIMS, as the government's marine research agency, to speed up the release of the coral cover report ahead of the WHC vote (Slezak, 2021). The Minister's Office also arranged a targeted preview, or 'leak', of the information to News Corp's national daily newspaper *The Australian* and its Queensland daily *The Courier Mail* (Slezak, 2021).

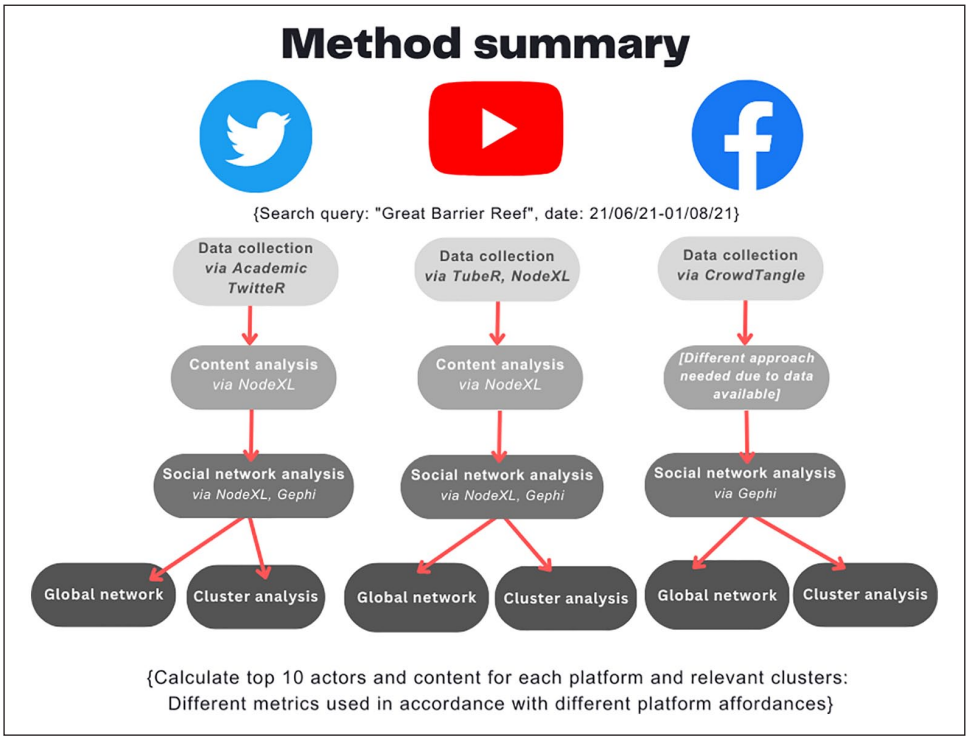

Figure 1. Overview of methodological approach, which includes data collection from social media platforms, content analysis and social network analysis. Conducting social network analysis at the global and cluster level helps to understand the key actors and the way information is flowing.

The coral cover report's initial release was covered by news organisations including, *The Australian, The Guardian* and public service broadcaster *ABC News*, but did not receive significant attention.[4] On Friday, 23 July 2021 – the day of the WHC decision – *The Australian* published a column from Dr Peter Ridd: 'Science and media doomsayers ignore good news on reef' (Ridd, 2021). Dr Ridd is a marine geophysicist who is now leading a Reef-related project[5] at Australian conservative thinktank the Institute of Public Affairs (IPA), and is connected to climate policy critics the Global Warming Policy Foundation (The Global Warming Policy Foundation (The GWPF), 2020). Dr Ridd's employment with James Cook University was terminated in 2018 for conduct issues, including public criticisms made to media about the veracity of Reef science (Konkes and Foxwell-Norton, 2021). Ridd's opinion column, behind a paywall, discussed the report's findings as 'good news', with a record high result of coral cover 'despite all the doom stories by our reef science and management institutions'. It went on to say that 'Record coral cover means there was no disaster on the reef. The only disaster is the quality assurance at the science organisations' (Ridd, 2021).

3. Dataset and methods

Data collection

Data for this study were collected across Twitter, YouTube and Facebook for the 6 weeks from Monday, 21 June 2021, 21.00 (UTC + 10) to Sunday, 1 August 2021, 23.59 (UTC + 10) (Figure 1).

This range captured the breaking news of UNESCO's draft recommendation and the WHC decision. The collection period ended a week after the WHC vote to ensure that commentary-style pieces were also included. The search query 'Great Barrier Reef' was used across all three social media platforms. While this encompassed the term without spaces and with a hashtag in front ('GreatBarrierReef' and '#GreatBarrierReef'), it did not capture content with only an abbreviation like 'the Reef' or a related term like 'UNESCO'. Where possible, the search parameter for English-language only was set. A limitation faced by all social media-based data collection is that every piece of content containing 'Great Barrier Reef' is unlikely to be collected, and different data collection tools can produce different datasets.

For Twitter, data were collected via R package academictwitteR (Barrie and Ho, 2021) using Twitter's API v.2 Academic Research product track. This resulted in a total of 85,818 tweets. The TweetIDs were imported into NodeXL (Smith et al., 2010) for further analysis, using the TweetID List Network. The importer was able to collect 84,941 of these 85,818 tweets.[6] Shortened URLs were expanded. YouTube data were collected via the YouTube API v.3 using R package TubeR (Sood, 2020). The 464 collected video IDs were imported into NodeXL via the YouTube User Network importer, which included discussions in the form of comments and replies on the keyword-matching videos. While there were some videos and comments containing non-English-language content, these were retained to ensure consistency with other collections.

Using the same search query and parameters as the other platforms, Facebook data were collected through CrowdTangle, which is a Meta-owned database for Facebook's public pages, groups and verified profiles. Hereafter, these are collectively referred to as Facebook spaces (following Bruns et al., 2020). Since changes were made to Facebook's API in 2018 data can be collected about the activities of pages and groups, not individual Facebook users, therefore the nature of data collected for Facebook is different from the other networks. The result was 4663 Facebook posts. As part of data cleaning, irrelevant content was removed before analysis.[7]

Mixed-methods data analysis

Social network analysis – as both method and theory[8] – was used to identify the most attention-getting actors and information sources on each platform and understand the associated informational interplays through visualisations (Grandjean and Jacomy, 2019; Himelboim et al., 2017; Wasserman and Faust, 1994). In-depth reading gave further insight into these exchanges and associated tactics (Graham et al., 2020). Data analysis for each network took a different approach according to the affordances of the platforms and the nature of the data available for collection (Figure 1).

To determine the most central actors within Twitter, the top 10 user accounts were identified via in-degree. A centrality metric, in-degree represents the authority of a node (account) in terms of incoming connections (Grandjean and Jacomy, 2019), which is an appropriate attention-getting metric for this study. While the top 10 Twitter accounts represented 0.02% of all accounts, they received 17.18% of all interactions. In-degree was also used for the YouTube data to reflect the level of interaction with, and therefore popularity of, each video channel account. In this case, the top 10 channels represented 0.23% of the YouTube accounts, yet received 42.8% of all interactions. A key limitation with this approach was some channels had their comment functionality disabled ($n = 70$). This meant comments and replies did not exist in the dataset, resulting in minimal incoming connections to these nodes (channels), aside from the initial publishing of the video (self-loop). While most of these accounts were individual users, notable YouTube channels that did not allow users to comment were *ABC News (Australia)* (six videos) and *Reuters* (three videos).[9] These mainstream media actors therefore had minimal in-degree rankings irrespective of other

channel metrics, for example, total number of views. To examine the most dominant Facebook spaces, the centrality metric of degree was used.[10] As these spaces are often information-based actors – like media outlets posting news content to their pages, or Facebook groups linking to external media content (Bruns et al., 2020) – it is an appropriate measure of informational authority for this platform. The top 10 accounts represented 0.41% of Facebook spaces in the sample and were associated with 5.6% of all interactions.

The next stage was qualitative analysis, including in-depth close reading (Graham et al., 2020). The top 10 actors were coded[11] according to their actor type. A full list of actors and the codebook is in Supplemental Material: S14. Media types were identified inductively via close reading (following Newman, 2017) and subcategories include Media non-news, Media mainstream news and Media alternative news. The criteria for classification are outlined in detail in Table S14. Media actors were further classified according to their political stance using independent website Media Bias Fact Check.[12] Non-media actors were coded in the context of mediatised environmental conflict (Foxwell-Norton and Konkes, 2018; Hutchins and Lester, 2015), with classifications modified accordingly or added inductively.

The most attention-getting content was calculated for each platform, determined according to platform affordances. For Twitter, a popular communications space for sharing news content (Park et al., 2022) with limited characters per Tweet, an effective way to further information is sharing a URL to an external source of information (Bruns and Stieglitz, 2013). URL frequency was therefore used as an indicator of prevalent information on Twitter. The top 10 URLs represented about 20% of the total links. For YouTube, prevalent content was determined by the volume of interactions on a video in the form of comments and replies – an indication of the content's salience in the context of a discussion network – which was crosschecked against video views for rigour. The top 10 videos represented about 30% of the total engagement. For Facebook, the most attention-getting content was determined by the volume of interactions on Facebook posts, with this metric encompassing reactions, comments and shares. This approach reflects that, unlike Twitter, only about half the posts included external links, and internal links (like facebook.com, which are created when a photo or 'native video' are uploaded) do not reveal much about the nature of the content. Unlike YouTube, video content comprised a much smaller portion of the dataset. The top 10 Facebook posts represented about 10% of the total interactions.

Network visualisations were created for each dataset, with these global networks and key subnetworks, or clusters, analysed for central actors and informational interplays (Dehghan et al., 2020; see Table S1: Supplemental Material for an overview of the networks, including nodes and edges). The Twitter and YouTube data were analysed by the Wakita-Tsurumi community detection algorithm (Wakita and Tsurumi, 2007) in NodeXL to evaluate the 10 most central actors and information sources in the largest clusters, and then compared with the respective global networks. The Twitter and YouTube data were then analysed using the Louvain community detection algorithm (Blondel et al., 2008) and mapped using the ForceAtlas2 force-directed layout algorithm (Jacomy et al., 2014) in open-source graphing software Gephi (Bastian et al., 2009). This additional topological perspective (Grandjean and Jacomy, 2019) helped with further interpreting information-sharing patterns, noting force-directed algorithms are useful for visually highlighting the relationships between closely related, or unrelated, nodes. The Facebook approach used the findings from these platforms and Facebook network visualisations to inductively drive the exploration of information-sharing patterns between key actors and content. The visualisation was created in Gephi using the Louvain clustering algorithm and ForceAtlas2 force-directed layout algorithm for consistency with the Twitter and YouTube visualisations.[13]

A limitation of this analysis is that it considers the top 10 actors and content only; however, a more extensive analysis reaches the same conclusions (Lubicz-Zaorski, 2022). This study does not

consider the role of other platform affordances and design factors in contributing to the salience of content, for example, the role of algorithms in making information more or less visible to hybrid user producers. Beyond a qualitative analysis of the most attention-getting actors in the YouTube data to code them as 'individual' or 'inauthentic', this work does not consider the presence or role of inauthentic accounts in furthering information flows at a broader scale.

4. Dominant actors and information flows

On all three social networks studied, we found digital traces of a small but influential group of conservative and partisan actors and tactics that are fuelling the 'denial machine'. While we did not set out to research the AIMS coral cover report, we found it was central to these actors' conversations on Twitter, YouTube and Facebook as a way to 'manufacture scientific controversy' (Ceccarelli, 2011) and undermine Reef science and protection. While actors and information sources varied in centrality across the three networks, a shared tactic was to repurpose and/or amplify opinion content from partisan mainstream media to further messages about the health of the Reef that aligned with their productivism goals. Productivism is understood as 'stress on economic growth as a prime value' (Giddens, 2009, in Hutchins and Lester, 2015: 342). The key actors, information and associated dynamics are outlined via each platform below.

Twitter

On Twitter, the cluster analysis shows the co-opting of the AIMS report to argue that the Reef had recovered and the science was flawed. The most attention-getting actors and content for the global network (Table S2: Supplemental Material) were substantially different from the largest interconnected cluster (Table S3: Supplemental Material). The top 10 actors in the global Twitter network include left-leaning politicians, advocates and media classified as politically 'left-centre' by Media Bias Fact Check. The exceptions to the left-leaning top 10 are Patrick Moore (number 7) – an influential critic of the need for growth-limiting climate policy (King et al., 2022), who says the Reef is not under threat from CO_2-caused climate change (Moore, 2021) – and former conservative coalition government Environment Minister, Sussan Ley. Moore is the most attention-getting actor in the largest subgroup within the global network and is joined by other (non-media) climate scepticism advocates (GWPF, Climate Realists), right-wing mainstream or alternative media (*Sky News Australia, Watts Up With That*,[14] *Fox News* contributor and self-professed 'influential climate science contrarian' Steve Milloy; see McKnight, 2012), and anti-climate action Australian conservative politician Matthew Canavan (2015). The outliers are business person and renewal energy advocate Simon Holmes à Court, environmental NGO Greenpeace and well-known environmental advocate Greta Thunberg. A targeted examination of the data suggests that these accounts are the subject of oppositional @mention tagging (Graham et al., 2020), which was used as a tactic to contest the dominant narrative that the Reef is under threat from climate change.

The top 10 URLs for the entire Twitter network are listed in the Supplemental Material (Table S4). *The Guardian* is convincingly the most central information source in the entire network in terms of frequency of URLs shared, with the outlet's content representing 7 of the top 10 URLs. This is consistent with other studies (Kirilenko and Stepchenkova, 2014; Newman, 2017), though further discussion about these associated information flows is outside the scope of this article (see Lubicz-Zaorski, 2022).

While the majority of the information sources are politically central or centre–left, according to Media Bias Fact Check, and reflect the position of the scientific consensus, an outlier is content from Patrick Moore/EcoSenseNow. The content is a Tweet that uses Ridd's opinion column that

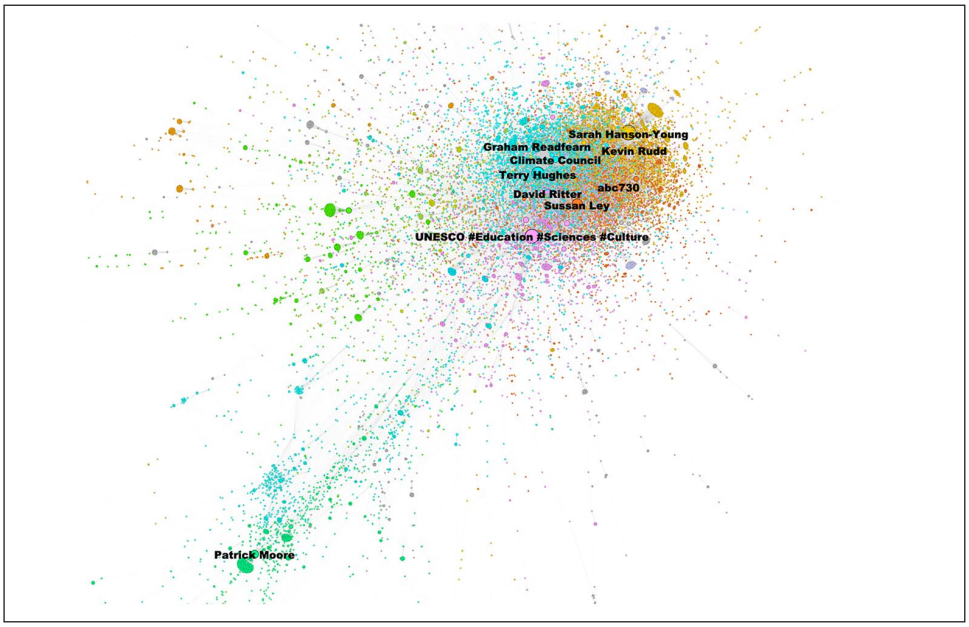

Figure 2. Top 10 actors in the Twitter network. For visual clarity, nodes are filtered by an in-degree range >4. Visualisation was created using the Louvain community detection algorithm and ForceAtlas2 force-directed layout algorithm with Gephi.
Modularity is by colour and nodes are sized by in-degree.

was originally published in *The Australian* as evidence of Reef recovery, calling Greenpeace and China 'liars' (Supplemental Material: S16). This tweet, while the seventh most prevalent piece of content overall, was the most dominant content in the largest subnetwork. In this cluster, 70% of the top 10 content either mentioned the AIMS coral cover report or Dr Peter Ridd, and called into question Reef and/or climate science (Supplemental Material: Table S5). That is, popular tweets in this cluster either shared URLs to alternative media outlets known to be climate contrarian advocates or republished Ridd's column – or commentary about the content of the column or the marine geophysicist's views – on their online platforms, including *Climatism*,[15] *Watts Up With That* and Australia-based *JoNova* (joannenova.com.au). The content was also used on the blog of London-based thinktank and climate policy critics, The Global Warming Policy Forum (GWPF),[16] now rebranded to Net Zero Watch (Bloomfield and Tillery, 2019). It was then amplified by Patrick Moore and other climate science critics like the Climate Realists. Another attention-getting information source in this cluster was a YouTube video by mainstream partisan media outlet *Sky News Australia*, which interviewed Ridd about the coral cover report (see below).

The exploratory visualisation created in Gephi supports the seeming ideological differences of the global network and largest subcluster (Figure 2). While the Louvain community detection algorithm classified actors differently from Wakita-Tsurumi, the key actors in the top 10 were similar, and using ForceAtlas2 produced useful visual insights that enriched the analysis. Figure 2 shows the Patrick Moore subnetwork distinctly removed from the main component of the global network. The polarised structure (Himelboim et al., 2017), and the differences in the information shared and attitudes of the global network compared with the Patrick Moore subnetwork, are analytical indicators of potential ideological and affective polarisation (Ross Arguedas et al., 2022). However,

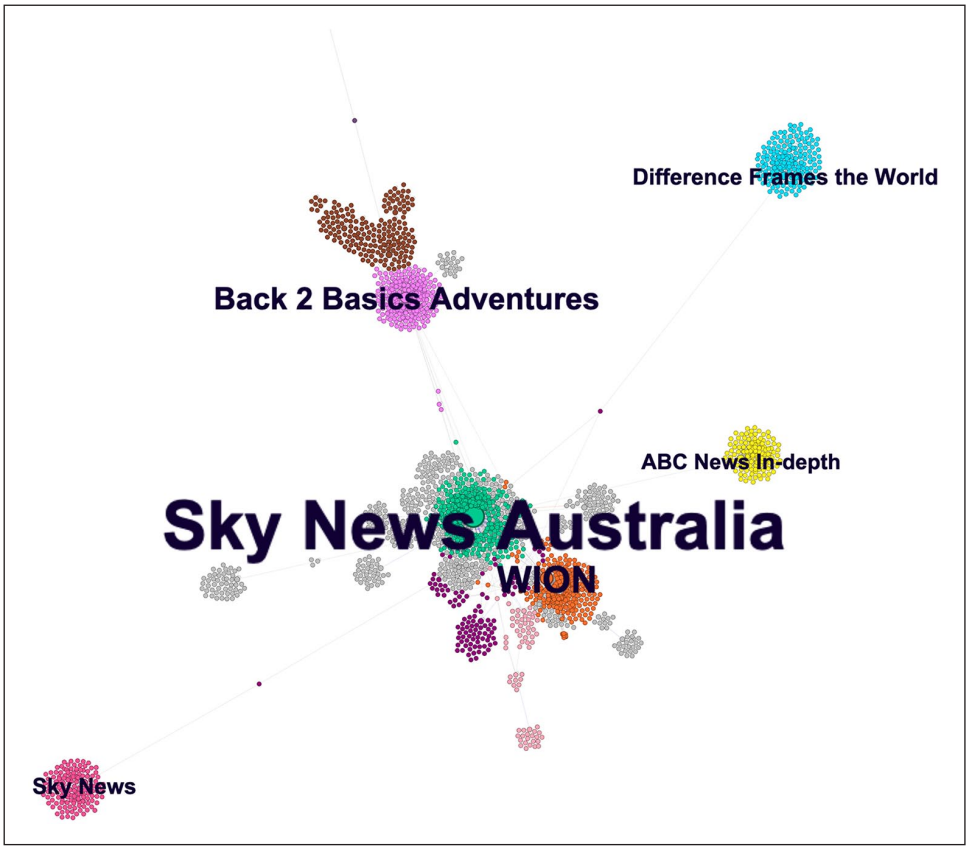

Figure 3. Top 10 actors of the YouTube network (note: 6 are shown and the remaining 4 actors have been cropped from the graph due to their spatial distance from the main component). Visualisation was created using the Louvain community detection algorithm and ForceAtlas2 force-directed layout algorithm with Gephi. Modularity is by colour and nodes and labels are sized by in-degree.

further analysis is needed of actors, content, information-sharing patterns, and in-group and out-group sentiment at an inter- and intra-cluster level (Dehghan et al., 2020).

YouTube

Within YouTube, AIMS' coral cover report was used to argue the Reef had recovered, and scientific institutions were flawed in some of the most attention-getting videos captured during data collection by the most central actor (Figure 3). *Sky News Australia* was the most dominant actor by far in this network, both globally and in the largest cluster (Supplemental Material Tables S6 and S7). The Australian subsidiary is different from *Sky News* (UK), which was number seven overall and is no longer owned by News Corp.

One of two key information threads about the coral cover report was an interview with Ridd, which was the same video that was prevalent on Twitter mentioned previously. This story, which features Ridd as the single source, was originally broadcast on the free-to-air channel and then posted to YouTube with the title: 'Data "unequivocally" shows Great Barrier Reef is in 'extremely

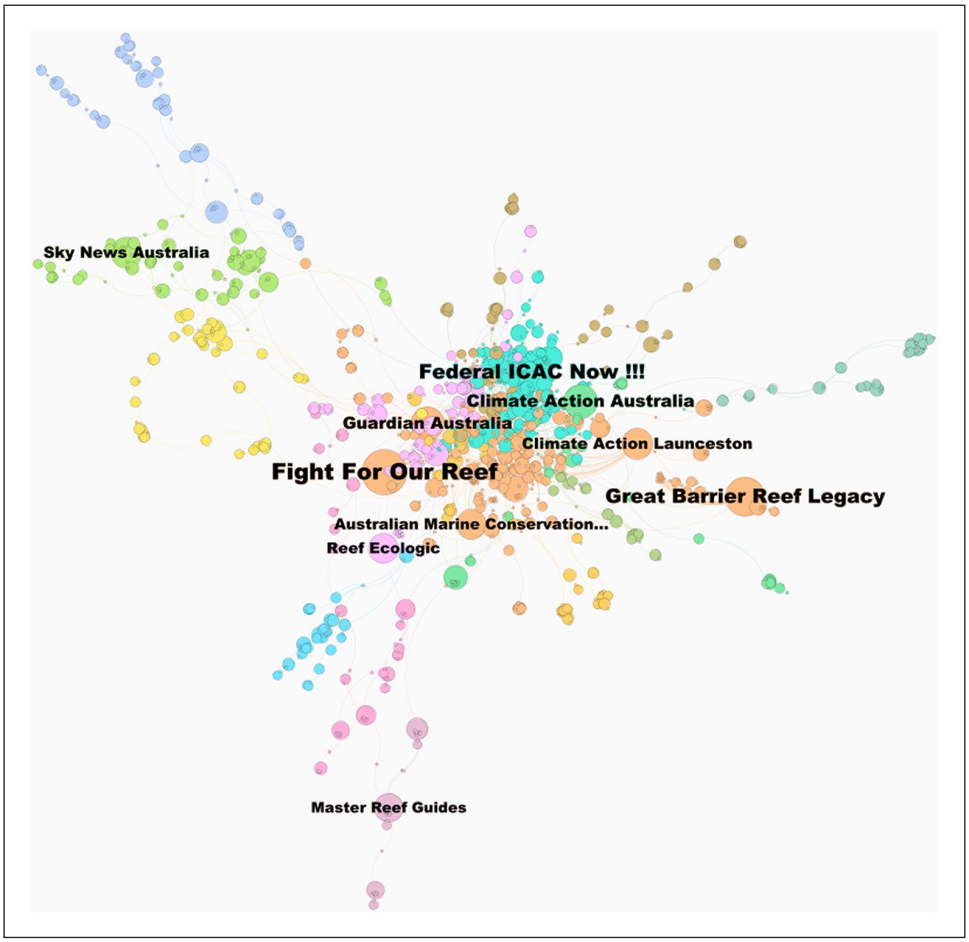

Figure 4. Top 10 Facebook spaces bipartite network. Visualisation was created using the Louvain community detection algorithm and ForceAtlas2 force-directed layout algorithm with Gephi. Nodes are both Facebook spaces and URLs. Node colour by modularity, node size and labels by degree. For visual clarity, all URL nodes have been reduced in size to focus attention on Facebook spaces.

good condition'" (Supplemental Material: Tables S8 and S10). The marine geophysicist discusses how the report's data show the threat of climate change is exaggerated, and questions the credibility of scientific organisations and the motivation of UNESCO (Supplemental Material: S9). The *Sky News Australia* host reinforces Ridd's views, saying, 'this is where all our institutions appear to be occupied by people who have an agenda irrespective of the data', highlighting how Ridd sought to 'expose' this and lost his job, and dismisses the 'in danger' threat as 'alarmist' designed to satisfy international diplomacy. The findings of the AIMS report were also co-opted by conservative Australian politician, Nationals Senator Matthew Canavan, in a *Sky News Australia* video on YouTube that was prominent in the cluster analysis (Supplemental Material: Table S10, number 9). At the end of an interview about another Reef-related conflict, host Chris Kenny asks Canavan about the outcome of the WHC decision. Canavan says it was a 'bittersweet victory', going on to say that the Reef had fully recovered and UNESCO's recent attention was the fault of problematic scientific reports, implying ulterior motives were at play (Supplemental Material: S11).

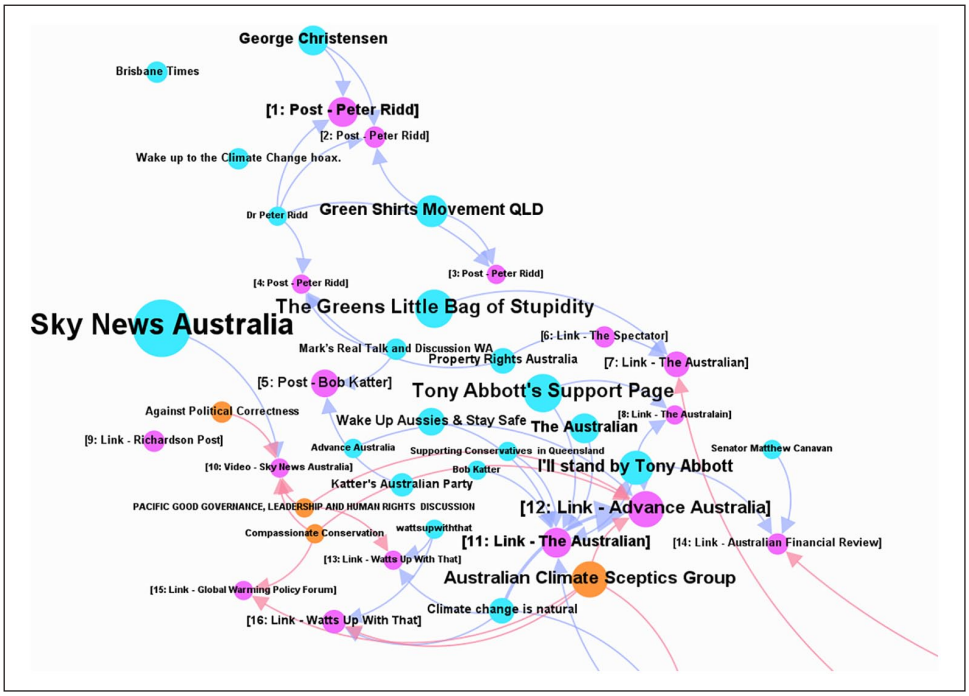

Figure 5. Facebook spaces and URLs bipartite network – close-up of top-left of Figure 4. Visualisation was created using the Louvain community detection algorithm and ForceAtlas2 force-directed layout algorithm with Gephi.
Filtered by a degree range >4, node colour by type (URL = purple, group = orange, page = blue) and size by degree. Labels are scaled to node size. NOTE: The degree range of >4 was set for readability, but this has removed a significant amount of content being shared in this cluster. Also to enhance legibility, the URLs (purple) have been replaced by numbers, the type of content, and the associated actor. The intact URLs are in Supplemental Material S18.

This interplay demonstrates how partisan right-wing media is able to amplify the voices of contrarian scientists and productivist politicians to attempt to undermine Reef science, downplay the threat of climate change and ultimately argue against the need for potentially growth-limiting action and policy. This is a tactic that has been attributed to News Corp's *Sky News Australia* and columnists from *The Australian* and is further discussed below.

Facebook

Facebook had a much stronger representation of advocacy actors in the top 10 than the other platforms (Supplemental Material: Table S12). The presence of two climate change advocacy groups – 'Climate Action Australia' and 'Climate Action Launceston' – shows how the protection of the Reef is strongly connected to the broader issue of climate change and Australian climate change policy. The dominance of *The Guardian Australia* and *Sky News Australia* at number five and six, respectively, is relevant in the context of the extreme difference in political stance and worldviews shared by these two mainstream news outlets (Park et al., 2022). Furthermore, *The Guardian's* dominance in the Twitter results and *Sky News Australia's* centrality in the YouTube results highlight the salience of these mainstream media actors across multiple online platforms.

In terms of the most prevalent content, information claiming the Reef was fully recovered – inspired by the strategic release of the AIMS report and Ridd's column – was present in two items in the top 10 Facebook posts, with another post about 'dodgy science' related to Ridd, but unrelated to the coral cover report, representing another central piece of content (Supplemental Material: Table S13). Mike Huckabee – a conservative US politician and former governor whose Facebook page describes him as 'the host of "Huckabee" on *TBN*, a *Fox News* and *Western Journal* contributor' – shared *Watts Up with That's* content about the coral cover report on his Facebook page. However, Facebook itself has since put a content warning on the post (Supplemental Material: S17). Conservative lobby group Advance Australia shared a link with its blog which uses the results from the AIMS coral cover report and Ridd's assurances 'the Reef is fine' to counter 'lies' that Queensland industry is destroying the Reef. Right-wing One Nation party leader Pauline Hanson also invokes truth claims, saying that Reef science is 'dodgy' and has damaged the economy, hashtagging prominent climate sceptic and *Sky News Australia* commentator and *The Australian* columnist Andrew Bolt and Ridd in her post.

It was also evident in the Facebook network that cogs of the 'denial machine' co-opted and channelled the coral cover report-related information. This can be observed via a close examination of a spatially removed subcluster. Figure 4 shows the Facebook spaces and URLs network, highlighting the top 10 Facebook spaces. The larger nodes in the main cluster are advocacy groups 'Fight for Our Reef', 'Federal ICAC Now !!!',[17] 'Great Barrier Reef Legacy', 'Climate Action Australia' and mainstream news outlet *Guardian Australia*. The two actors that are spatially separate are Reef tourism ambassador programme Master Reef Guides and *Sky News Australia*.

Figure 5 takes a closer look at the *Sky News Australia* subgroup. By examining the names of Facebook spaces and the URLs shared, this cluster appears ideologically different from the main cluster. Information sources include *Sky News Australia, The Australian*, climate sceptics the GWPF, *Watts Up With That*, and the *Spectator* and their associated content that uses AIMS' coral cover report to argue the Reef has recovered. The pages and groups include right-wing Australian fossil fuel-supporting politicians George Christensen (former Nationals MP and One Nation candidate), Nationals Senator Canavan, and pages supporting former conservative Australian prime minister and climate policy opponent Tony Abbott[18] (Wilkinson, 2020); Dr Peter Ridd; conservative advocacy groups like 'Against Political Correctness'; and climate denial and scepticism actors 'Wake up to the Climate Change hoax', 'Climate change is natural', and the 'Australian Climate Sceptics Group'. These Facebook spaces share content that draws upon AIMS' coral cover report or associated commentary delegitimising Reef and climate science to further the counternarrative that the Great Barrier Reef has recovered, climate change alarmists are overreacting, the science is flawed and ultimately argue that growth-limiting policy is not needed.

5. Fuelling the Australian 'denial machine'

Our results show how small-yet-impactful clusters of free-market and contrarian actors are using established tactics to challenge Reef science and climate action, thus fuelling a US-style 'denial machine' in Australia-centric online discussions. Understanding that scientific information often informs policymaking, and that publics are informed about Reef and climate change science and policy through news-sharing spaces (Holmes and Star, 2018), we show how science was co-opted to suit the particular goals of ideologically aligned actors embedded in contemporary communications networks. In the case of the Great Barrier Reef 2021 UNESCO 'in danger' recommendation, a small but influential group of alternative media and certain non-media actors – including productivism advocates and conservative political actors – were able to repurpose and/or amplify content

from mainstream media to further messages about the health of the Reef that aligned with their free-market values and opposition to potentially growth-limiting policy.

In effect, although there is no evidence to suggest their efforts are explicitly coordinated, these actors work together as mutually reinforcing cogs of a broader climate 'denial machine'. There is a deep and long-recognised interplay of these actors in other Western capitalist democracies, like the United States. Here, a series of climate action obstructors (Ekberg et al., 2022) initially sought to establish scientific doubt (Oreskes and Conway, 2010), but have since expanded to 'manufacture scientific controversy' by creating conflict within science itself (Ceccarelli, 2011). Tactics have historically included using contrarian scientists as 'heroes' to undermine the peer review process; criticise research funding practices and scientific institutions (e.g. claims of corruption); and question the expertise and ethical motivations of consensus-supporting scientists themselves (Ceccarelli, 2011). These informational dynamics are generally problematic, but are specifically concerning when coupled with the 'politicization of science' creating a barrier to public support for much-needed climate action (IPCC, 2022, in King et al., 2022: 44); the politicisation and mediatisation of the Reef and climate change policy in Australia (Konkes and Foxwell-Norton, 2021); and other contextual factors like Australia's concentrated media ownership (Newman et al., 2022).

The protection of the Great Barrier Reef – an ecological, cultural and economic icon that has been historically politicised and mediatised (Foxwell-Norton and Konkes, 2018) – is arguably now the poster child for the inadequacy of global climate action and policy, with the spotlight on the Australian federal and Queensland state governments and any activities that could compromise the Reef's health (Morrison et al., 2020). Yet some economically driven lobby groups are concerned that enhanced protection measures could stifle the production capacity of Reef catchment-based industries, erode extractive industries' social licence to operate and even threaten the (pre-COVID) US$6.4 billion per annum tourism industry (Deloitte Access Economics, 2017);[19] therefore there is cause to convey a healthy Reef. In other words, if a credible scientific report says the Reef has recovered, the threat of climate change is therefore overstated, which negates the need to mitigate human behaviour, including increasing government regulation and reducing consumption and production: actions that would challenge hegemonic Western capitalist social order (Jacques, 2006).

Using a mixed-methods approach to study three relevant news-sharing platforms, we empirically demonstrate how some cogs of an Australian 'denial machine' are furthering a narrative about the Reef's health that reflects these actors' shared conservative political stance and productivism values. Tracing information flows beyond the social media networks illustrates how the then-conservative government strategically steered the release of its own government agency's scientific report, framing its findings and channelling these to ideologically aligned News Corp media as a 'leak'. Using social network analysis and in-depth close reading, informational threads were tracked within the three networks to understand connections with like-minded actors. Yet while the cogs of the US-style 'denial machine' are turning in the case of Reef protection – now inextricably linked to climate change conflict – there is nothing novel about the tactics used (Ceccarelli, 2011; Dunlap and McCright, 2015; Oreskes and Conway, 2010). The tried and tested playbook is simply transposed into contemporary communication spaces. In this case study, a conservative think tank-aligned contrarian scientist, Dr Peter Ridd, countered consensus views with claims about flawed science and institutions (Bacon and Jegan, 2020; Grien and Macneil, 2022). Scientific controversy was manufactured through cherry picking and reframing the findings of a scientific report, namely claiming the Reef had recovered and was not under threat from climate change – ignoring AIMS' caveat that it was in a fragile recovery window – and amplifying this narrative through the legitimacy of mainstream media in the form of opinion. In this case it was via News Corp-owned *The Australian*, and then channelled from a limited paying audience into the global and free access provided by alternative media actors and the blogs of ideologically aligned lobby groups. These

included prominent climate scepticism blog *Watts Up With That* (Dunlap and McCright, 2011; Kirilenko and Stepchenkova, 2014), policy-delay advocates the Global Warming Policy Forum/ Net Zero Watch (Bloomfield and Tillery, 2019) and conservative lobby group Advance Australia. These views were legitimised by conservative political actors seeking to reinforce their ideologies about productivism and the free market, including Nationals Senator Matthew Canavan. These elite actors' interpretations were then amplified by partisan mainstream media driven to maximise audiences through adversarial framing and content, most prominently *Sky News Australia*, but also via *Fox News* contributors Mike Huckabee and Steve Milloy. Meanwhile, grassroots individual and group advocates continued to further the information flows as they unfolded, amplifying the 'evidence' that supported their climate change scepticism advocacy logic. This included influential climate policy critic Patrick Moore, who was a key actor in circulating climate change misinformation during COP26 (King et al., 2022), and central Facebook groups like 'Wake up to the Climate Change hoax', 'Climate change is natural' and the 'Australian Climate Sceptics Group'.

While similar (McCright and Dunlap, 2011) and different (Merkley and Stecula, 2018) actors and tactics have been highlighted in obfuscating climate change debate in the United States, Dunlap and McCright (2011) argue the 'denial machine' has since tracked to other nations with conservative governments and established conservative thinktanks, like Australia (until May 2022) and the United Kingdom. Conservative thinktanks undermine climate policy, with these seemingly neutral organisations positioning themselves as alternative academia with unbiased experts (Beder, 2001, as cited in Dunlap and McCright, 2015). However, key funders include billionaires with links to extractive industries that are opposed to growth restrictions resulting from environmental policy. In Australia, the IPA works with marine geophysicist Ridd, with Ridd leading a Reef-related project seeking to challenge media narratives about the Reef's ailing health and address 'bad science' and academic censorship (Institute of Public Affairs, 2022). While the IPA does not publicly disclose its funders, investigations have shown an Australian mining magnate has funded up to half of its activities (Seccombe, 2018). Dunlap and McCright (2011) discuss the impact of the IPA in furthering the US-style 'denial machine' in Australia by helping to derail environmental policy in the name of mining interests, and supporting contrarian scientists. This includes amplifying their ideas through media contacts, including the Murdoch tabloids (Taylor, 2014; Wilkinson, 2020).

This strategy is particularly relevant considering News Corp and Nine Entertainment Co. collectively control more than 80% of the metropolitan and national print markets in Australia (Newman et al., 2022), and Murdoch-owned media outlets are already identified as crucial cogs in the US climate 'denial machine' (Dunlap and McCright, 2011). News Corp has received considerable scholarly attention for its confusion of climate change discourse. The multi-platform publisher often privileges the voices of climate sceptics, particularly through opinion pieces and commentary; has politicised science; and has either denied or ignored climate science news, including events relating to the Reef (Bacon and Jegan, 2020; Chubb, 2012; Grien and Macneil, 2022; Holmes and Star, 2018; McKnight, 2012; Manne, 2011). Recent work also highlights how partisan Australian broadcaster *Sky News Australia* provides an influential mainstream platform for climate sceptics and deniers from all over the world, with many of its commentators and staff having ties to conservative politics and leveraging News Corp's other media platforms to cross-promote and amplify these views (King et al., 2022), a finding supported in this work. This research also found *Sky News Australia* was a central actor on YouTube in particular, and on Facebook. *Sky News Australia* is now available for free on commercial television (Copland et al., 2021), has a YouTube subscribership of 2.55 million (June 2022 figures), and is Australia's most watched media producer online (King et al., 2022). As noted earlier, there are links between conservative political ideology and scepticism in Australia (Hornsey et al., 2018), with *Sky News Australia's* audience less likely to think climate change is serious compared with the audiences of other mainstream news outlets

(Park et al., 2020). While further research is needed on the impact of this outlet in helping to shape public opinion, this article indicates that – due to its centrality in YouTube and Facebook and the ability for its content to contest dominant Reef health and protection narratives across all networks – *Sky News Australia* is a well-oiled cog of the 'denial machine' in Australia and perhaps beyond.[20]

6. Conclusion and further work

This multi-platform study gives an insight into how the climate change 'denial machine' is fuelled in Australia, showing how dismissive narratives relating to the Reef's health, and climate change action more broadly, are co-opted and channelled in key communication spaces. While scholars have already observed how Australian climate policy is stifled by such interactions, this article empirically demonstrates the interplay of a small but influential group of conservative partisan actors to argue the Great Barrier Reef has recovered, the threat of climate change is exaggerated, and the need for climate policy is unwarranted. Further work is needed to investigate the responses to information flows in the form of comments/replies to gain insights into the degree of support for the views expressed and furthered by partisan actors. This extended analysis could help to advance understanding about the extent that these views are shared, which – combined with other approaches – could ultimately provide further insights into the dynamics of online communication spaces and how these interplays contribute to knowledge generation. Specifically, understanding the actors, information flows and tactics that are specific to the Australian context could offer benefits in mitigating damaging impacts from the 'denial machine', such as the extent to which climate change has been politicised and polarised in the United States (Dunlap and McCright, 2011; Hornsey et al., 2018).

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Supplemental material

Supplemental material for this article is available online.

Notes

1. The United Nations Educational, Scientific and Cultural Organisation (UNESCO) and the International Union for Conservation of Nature (IUCN) have pulled this lever in the past to spur the Australian federal and Queensland state governments into lifting their protection efforts (Morrison et al., 2020).
2. This meeting was postponed as it was scheduled for Russia. It was held in Saudi Arabia in September 2023. While the Reef was again recommended for an 'in danger' listing in November 2022, the draft

decision was revised in July 2023. It was not listed as 'in danger' at the 2023 meeting.
3. More information about AIMS' methods and the data used to reach this conclusion can be found here: https://www.aims.gov.au/reef-monitoring/gbr-condition-summary-2020-2021 and https://eatlas.org.au/gbr/ltmp-data.
4. The URLs for these items of content were not dominant in the platform analyses.
5. Dr Ridd and colleague Dr Jennifer Marohasy launched an initiative at the Institute of Public Affairs (IPA) in 2022 called the 'Project for Real Science'. The project targets 'young Australians' to show the Reef first-hand to challenge 'the media narrative they otherwise consume' (Institute of Public Affairs, 2022). It also aims to address 'bad science' and academic censorship (Institute of Public Affairs, 2022).
6. When the missing 877 tweets were queried with the Social Media Research Foundation (NodeXL's developer), an explanation provided was these tweets were likely to have been deleted in the interim. There was an approximately 3-week period in between collecting the Tweets via AcademicTwitteR and importing the Tweet IDs into NodeXL.
7. To be considered relevant, content did not need to mention the WHC/UNESCO event directly, but needed to relate to Reef protection, policy, science or threat mitigation. General tourism posts that did not mention threat mitigation, fishing-related videos and irrelevant non-Reef-related content were excluded. Shorter versions or duplicates were merged.
8. For more information about social network theory and its relevance to this research, see Supplemental Material S19.
9. For comparison, *Sky News Australia* had 14 videos in the dataset.
10. Out-degree could have been used as an alternative metric, with the same result in this case.
11. All coding for this research was conducted by Author 1, meaning there was no need for intercoder reliability checks.
12. Media Bias Fact Check is an independently owned website that classifies the political bias, factual accuracy and credibility of range of media sources. While it has a defined method to rate all media outlets, there are limitations, including not being accredited, or an academic source.
13. A tutorial is available here: https://help.crowdtangle.com/en/articles/4495952-network-mapping-with-gephi-and-crowdtangle
14. Ekberg et al. (2022) note that blog publisher, Anthony Watts, has been funded by US influential conservative think tank, the Heartland Institute.
15. Since data collection, Twitter has suspended this account.
16. The Global Warming Policy Forum is the campaigning wing of the Global Warming Policy Foundation. The Foundation has an Academic Advisory Council that Dr Peter Ridd is on.
17. This group was advocating for a national anti-corruption commission in Australia, which has since been established (NACC).
18. Conservative Katter's Australia Party and party leader Bob Katter are in this group, but they are focused on furthering the narrative that blames the Reef 'in danger' recommendation as an ambush from China and the UN, which is outside the scope of this article (see Lubicz-Zaorski, 2022).
19. Some argue an 'in danger' listing could deter tourists, while others say these claims are unfounded (Day et al., 2021).
20. Since this research was conducted, the Australian Communications and Media Authority (ACMA) found *Sky News Australia* breached the code of practice by not accurately representing the findings of the AIMS coral cover report (ACMA, 2023).

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Theresa Petray is an Associate Professor in Sociology, and Head of Humanities, Arts and Social Sciences at James Cook University. She is also a Fellow at The Cairns Institute, and Theme Leader for the Social & Environmental Justice Theme there. Her research focuses on social change and activism, primarily in terms of First Nations self-determination and Indigenous Nation Building. She is particularly interested in the ways seemingly marginalised people exercise agency to speak back to power and create alternatives.