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# Marine heatwaves threaten global biodiversity and the provision of ecosystem services

Dan A. Smale<sup>1,2,20\*</sup>, Thomas Wernberg<sup>1,2,20</sup>, Eric C. J. Oliver<sup>3,4,5</sup>, Mads Thomsen<sup>6</sup>, Ben P. Harvey<sup>7,8</sup>, Sandra C. Straub<sup>2</sup>, Michael T. Burrows<sup>9</sup>, Lisa V. Alexander<sup>10,11,12</sup>, Jessica A. Benthuyssen<sup>13</sup>, Markus G. Donat<sup>10,11,14</sup>, Ming Feng<sup>15</sup>, Alistair J. Hobday<sup>16</sup>, Neil J. Holbrook<sup>4,17</sup>, Sarah E. Perkins-Kirkpatrick<sup>10,11</sup>, Hillary A. Scannell<sup>18</sup>, Alex Sen Gupta<sup>10,11</sup>, Ben L. Payne<sup>9</sup> and Pippa J. Moore<sup>1,7,19</sup>

<sup>1</sup>Marine Biological Association of the United Kingdom, The Laboratory, Citadel Hill, Plymouth, UK. <sup>2</sup>UWA Oceans Institute and School of Biological Sciences, The University of Western Australia, Crawley, Western Australia, Australia. <sup>3</sup>Department of Oceanography, Dalhousie University, Halifax, Nova Scotia, Canada. <sup>4</sup>Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Australia. <sup>5</sup>Australian Research Council Centre of Excellence for Climate System Science, University of Tasmania, Hobart, Tasmania, Australia. <sup>6</sup>Centre of Integrative Ecology and Marine Ecology Research Group, School of Biological Sciences, University of Canterbury, Private Bag, Christchurch, New Zealand. <sup>7</sup>Institute of Biological, Environmental and Rural Sciences, Aberystwyth University, Aberystwyth, UK. <sup>8</sup>Shimoda Marine Research Center, University of Tsukuba, Shizuoka, Japan. <sup>9</sup>Department of Ecology, Scottish Association for Marine Science, Scottish Marine Institute, Oban, Argyll, UK. <sup>10</sup>Climate Change Research Centre, The University of New South Wales, Sydney, New South Wales, Australia. <sup>11</sup>Australian Research Council Centre of Excellence for Climate Extremes, The University of New South Wales, Sydney, New South Wales, Australia. <sup>12</sup>Australian Research Council Centre of Excellence for Climate System Science, The University of New South Wales, Sydney, New South Wales, Australia. <sup>13</sup>Australian Institute of Marine Science, Crawley, Western Australia, Australia. <sup>14</sup>Barcelona Supercomputing Center, Barcelona, Spain. <sup>15</sup>CSIRO Oceans and Atmosphere, Crawley, Western Australia, Australia. <sup>16</sup>CSIRO Oceans and Atmosphere, Hobart, Tasmania, Australia. <sup>17</sup>Australian Research Council Centre of Excellence for Climate Extremes, University of Tasmania, Hobart, Tasmania, Australia. <sup>18</sup>School of Oceanography, University of Washington, Seattle, WA, USA. <sup>19</sup>Centre for Marine Ecosystems Research, School of Natural Sciences, Edith Cowan University, Joondalup, Western Australia, Australia. <sup>20</sup>These authors contributed equally: Dan A. Smale and Thomas Wernberg. \*e-mail: [dansma@mba.ac.uk](mailto:dansma@mba.ac.uk)

## Supplementary information

### Marine heatwaves threaten global biodiversity and the provision of ecosystem services

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#### Affiliations:

1. Marine Biological Association of the United Kingdom, The Laboratory, Citadel Hill, Plymouth PL1 2PB, UK
2. UWA Oceans Institute and School of Biological Sciences, The University of Western Australia, Crawley 6009 Western Australia, Australia
3. Department of Oceanography, Dalhousie University, Halifax, Nova Scotia, B3H 4R2, Canada
4. Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Australia
5. Australian Research Council Centre of Excellence for Climate System Science, University of Tasmania, Hobart, Tasmania, Australia
6. School of Biological Sciences, University of Canterbury, Private Bag 4800, Christchurch, New Zealand
7. Institute of Biological, Environmental and Rural Sciences, Aberystwyth University, Aberystwyth SY23 3DA, UK
8. Shimoda Marine Research Center, University of Tsukuba, 5-10-1 Shimoda, Shizuoka, 415-0025, Japan
9. Department of Ecology, Scottish Association for Marine Science, Scottish Marine Institute, Oban, Argyll, PA37 1QA, Scotland, UK.
10. Climate Change Research Centre, The University of New South Wales, Sydney, New South Wales, Australia
11. Australian Research Council Centre of Excellence for Climate Extremes, The University of New South Wales, Sydney, New South Wales, Australia
12. Australian Research Council Centre of Excellence for Climate System Science, The University of New South Wales, Sydney, New South Wales, Australia
13. Australian Institute of Marine Science, Crawley, Western Australia, Australia
14. CSIRO Oceans and Atmosphere, Crawley, Western Australia, Australia
15. CSIRO Oceans and Atmosphere, Hobart, Tasmania, Australia
16. Australian Research Council Centre of Excellence for Climate Extremes, University of Tasmania, Hobart, Tasmania, Australia
17. School of Oceanography, University of Washington, Seattle, WA, USA
18. Centre for Marine Ecosystems Research, School of Natural Sciences, Edith Cowan University, Joondalup 6027 Western Australia, Australia

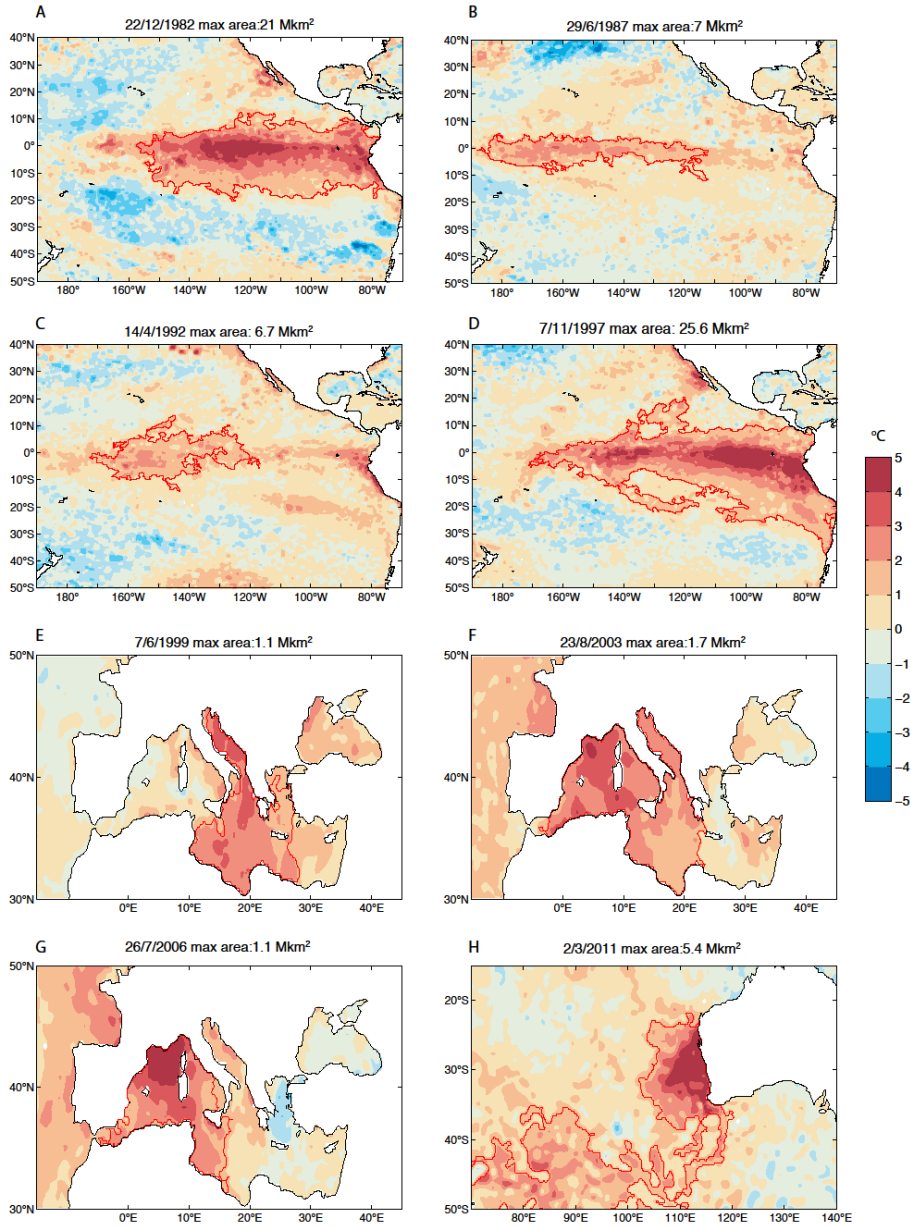
**Correspondence:** Dan Smale, email [dansma@mba.ac.uk](mailto:dansma@mba.ac.uk)

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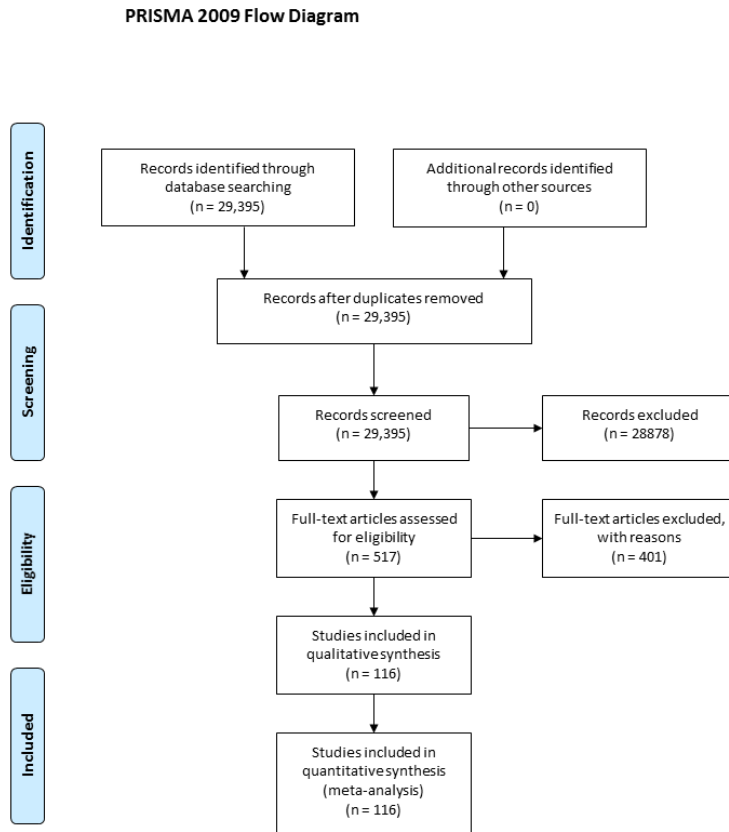
Supplementary Figs. S1 to S5

Supplementary Tables S1

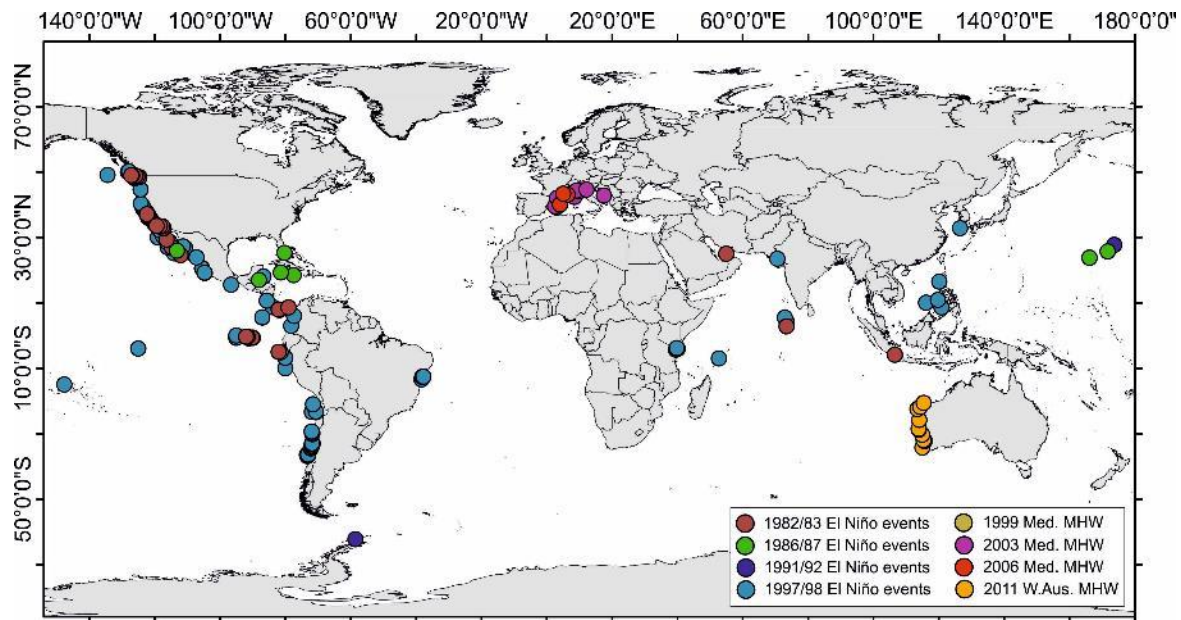
**Fig. S1.** The maximum spatial extents of the eight warming events included in the meta-analysis: Events associated with El Niños in (A) 1982/1983, (B) 1986/1987, (C) 1991/1992 and (D) 1997/1998, and (E) the 1999 Mediterranean MHW, (F) the 2003 Mediterranean MHW, (G) the 2006 Mediterranean MHW, and (H) the 2011 Ningaloo Niño MHW. Colours indicate the associated sea surface temperature anomalies (relative to baseline seasonal climatology, 1983-2012). Red contour indicates the largest contiguous area experiencing MHW conditions over the course of the MHW in the associated region (date and area [million km<sup>2</sup>] shown in panel title).



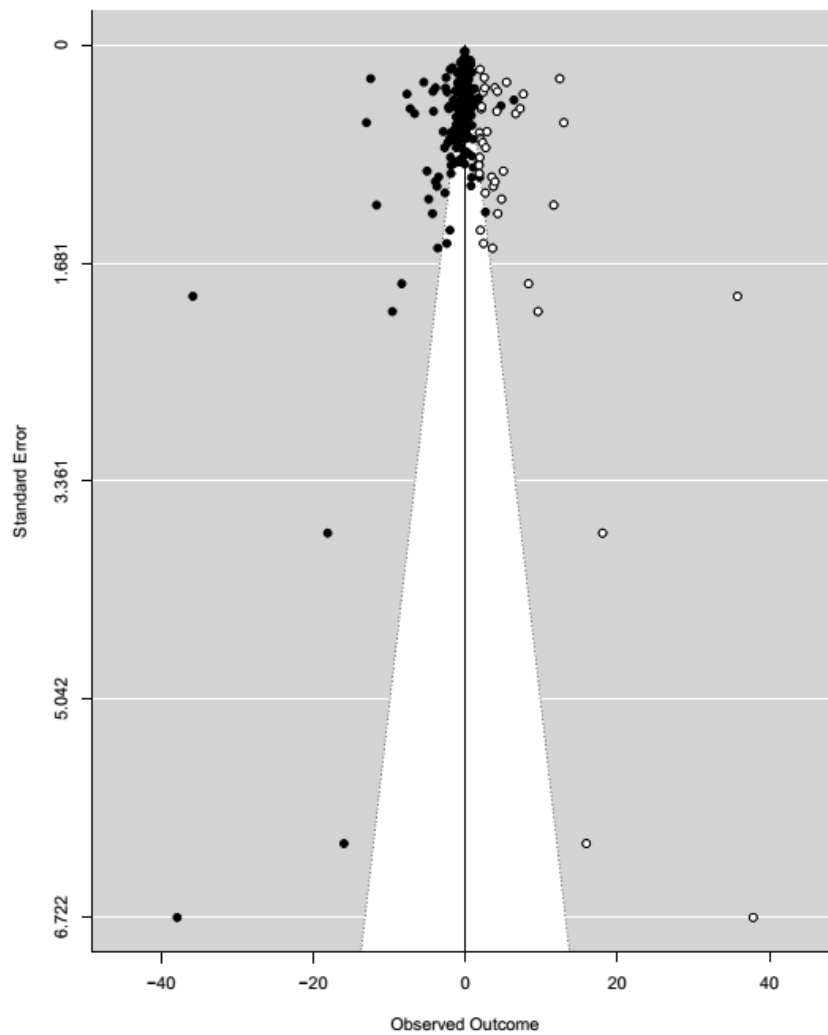
**Fig. S2.** PRISMA flow diagram relating to the meta-analysis of MHW impacts. PRISMA framework adopted from Moher et al. (2009) Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6: e1000097.



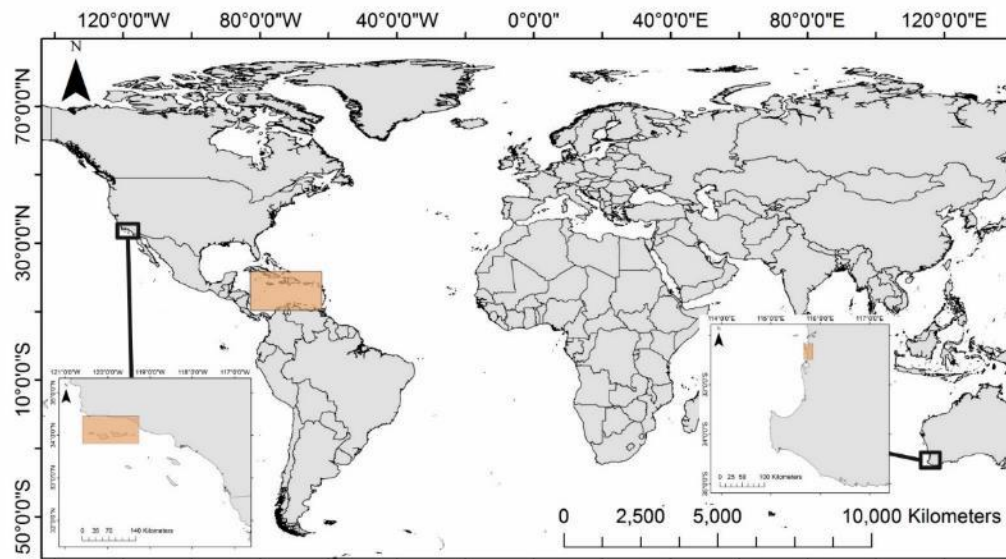
**Fig. S3.** Map indicating locations of observational studies included in the meta-analysis of ecological impacts of MHWs. Map generated using ArcGIS 10.4 software.



**Fig. S4.** Funnel plots of effect sizes extracted from the meta-analysis of MHW impacts. Filled circles are observed data ( $n = 182$ ), while open circles are simulated data generated by the trimfill method to correct asymmetry of the funnel plot.



**Fig. S5.** Map indicating location and spatial extent of study regions used for the analysis of MHW impacts on habitat-forming species (see Fig. 3 main text). Map generated using ArcGIS 10.4 software.



**Table S1.** Correlation coefficients (Pearson's  $r$ ) between three metrics of ocean climate (annual number of MHW days, annual mean SST, annual maximum SST) and the health of coral, seagrass and kelp. Coral bleaching data were collated for the Caribbean Sea region, seagrass metrics were recorded in Western Australia and kelp biomass was quantified for the California/Baja California region (see Fig. 3 main text). NB for both seagrass density and kelp biomass, ocean climate variables from the previous year were correlated with ecological variables; kelp biomass was Ln transformed. Significant correlations are indicated as follows: \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$ .

	<b>Coral bleaching</b>	<b>Seagrass density</b>	<b>Kelp biomass</b>
<b>MHW days</b>	0.71***	-0.62*	-0.58**
<b>Mean SST</b>	0.53**	-0.39	-0.49**
<b>Max. SST</b>	0.56**	0.09	-0.23