The biggest health threat facing humanity

The response from physiology

Professor Mike Tipton
The Physiological Society, University of Portsmouth

The Guardian

Portugal

Dozens injured in wildfires as high of 43C looms

More than 3,000 firefighters battle blazes as EU offers emergency help and temperatures could hit 43C

More on this story

Weather Heatwave in south-east England could hit 33C this week

10 July 2022

The Physiological Society

UK weather: 'Extreme heat' alert for Sunday as Met Office warns of life-threatening conditions

Hot weather could break all-time records, with some models suggesting conditions hotter than 40C are possible

By Olivia Rudgard, ENVIRONMENT CORRESPONDENT
11 July 2022 • 10:01pm

11 July 2022

Species extinction, widespread disease, unliveable heat, ecosystem collapse and cities menaced by rising seas will become painfully obvious before a child born today turns 30.

IPCC Science Report 2021

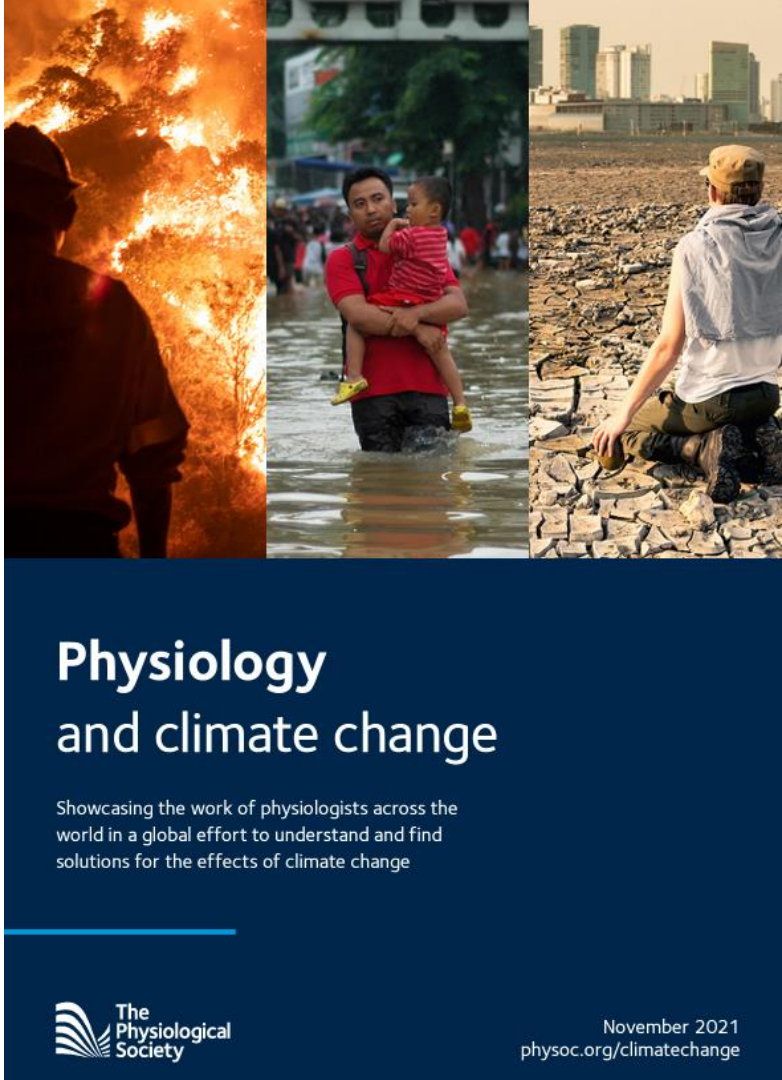
10 extreme events (e.g. Hurricane Ida, US and flooding in Europe) each caused more than $1.5bn of damage.

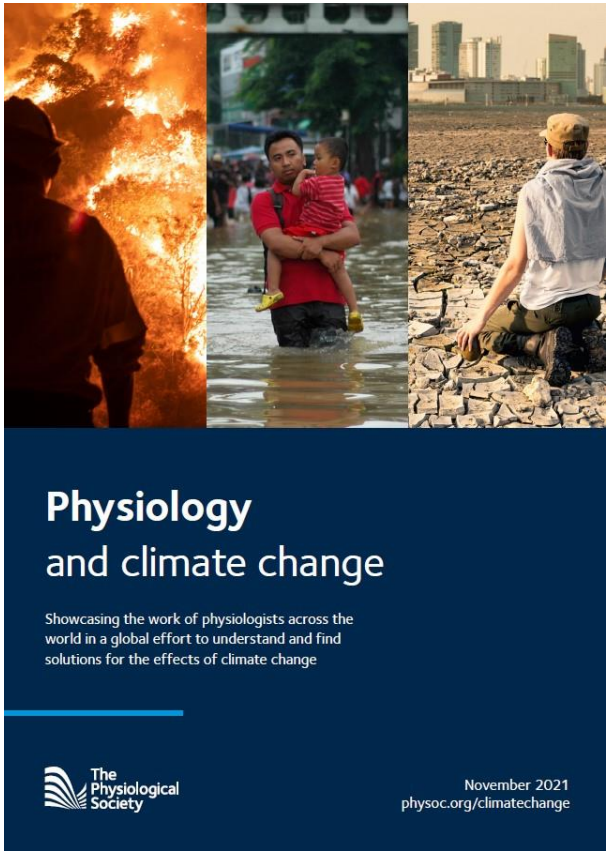
Direct damage costs to health (i.e. excluding costs in health-determining sectors such as agriculture and water and sanitation), is estimated to be between USD 2-4 billion/year by 2030.

Christian Aid/WHO 2021

The Physiological Society & Climate Change

- Climate Change Hub (physoc.org/climatechange)
- Released ‘Physiology and Climate Change’ report in October 2021
- Roundtable with Wellcome Trust in January 2022
- Event with Foundation of Science and Technology in July 2022
- World Health Summit session in October 2022





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Some ways physiologists are responding to the climate emergency:

- Heat exposure for workforces and other under-researched groups (e.g. pregnant people)
- Deteriorating air quality
- Flooding and drowning risk
- Food safety
- Animal conservation
- Mental health and wellbeing

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The Climate Emergency: Research Gaps and Policy Priorities

The Physiological Society

July 2022
physoc.org/climatechange

Physiology & Climate change

The Challenge

- Increased Average temperatures
- Extreme Weather Events
  - Wildfires
  - Hurricanes
  - Floods
  - Heat waves
  - Cold snaps
- Pollution
- Disease

The Response

- Building design & urban planning
- Understanding pathophysiology
- Nutritional guidelines
- Public Health Guidelines
- Occupational Health Guidelines
- Clothing design
- Respiratory protection
- Cooling solutions
- Acclimatisation
- Protecting vulnerable populations
- Protecting biodiversity

Physiology & Climate change

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Heat-related problem	Mechanisms	Solutions?	More information required
Increased CV strain resulting in illness	Dehydration, Vascular physiology	• Acclimation • Acclimatisation • Increased heat tolerance • Manipulate thermal comfort • Personalised microclimate cooling • PPE design • Work-rest schedules • Occupational physiological assessments	• Impact of chronic exposure to heat • Impact of heat on neurophysiological function • Microbiome • Cellular response and tolerance variations • Genetic influences • Acclimation potential • Impact of chronic heat on specific populations (children, elderly, women, pregnant women, disabled, comorbidities,) • Field studies • Novel mitigations • Artificial cooling • PPE • Smart buildings • Cross adaptation
Increased thrombi formation resulting in illness	Dehydration, Vascular physiology, Cardiac physiology		
Hyperthermia/Heat exhaustion/Heat Stroke	Fatigue, multi-organ failure, Impaired gut function, Sepsis		
Aggravation of existing conditions (Cardiac problems, MS, Epilepsy…)	Neurophysiological function, vascular physiology		
Diminished workability / productivity	Dehydration, Fatigue/Exhaustion		

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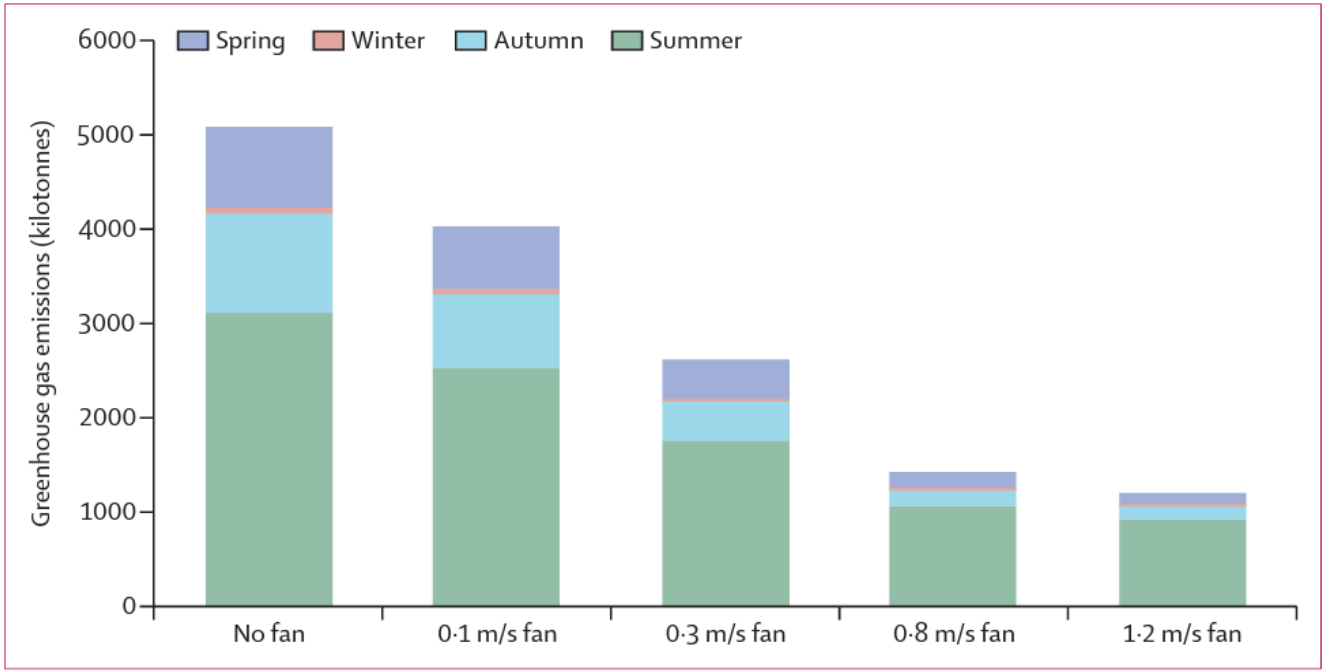
Contribution of physiology to addressing the thermal challenge of increasing temperatures resulting from climate change

Responses to extreme heat

- Thermal physiology refers to the study of the biological implications of fluctuations in temperature on the human body.
- Using thermal physiology, we can understand how to alter people's preferences such that they are able to remain comfortable in warmer indoor environments, reducing their reliance on energy consuming devices such as air conditioning.
- This could include enhanced natural convective cooling or evaporative cooling techniques in which water evaporation cools hot air.

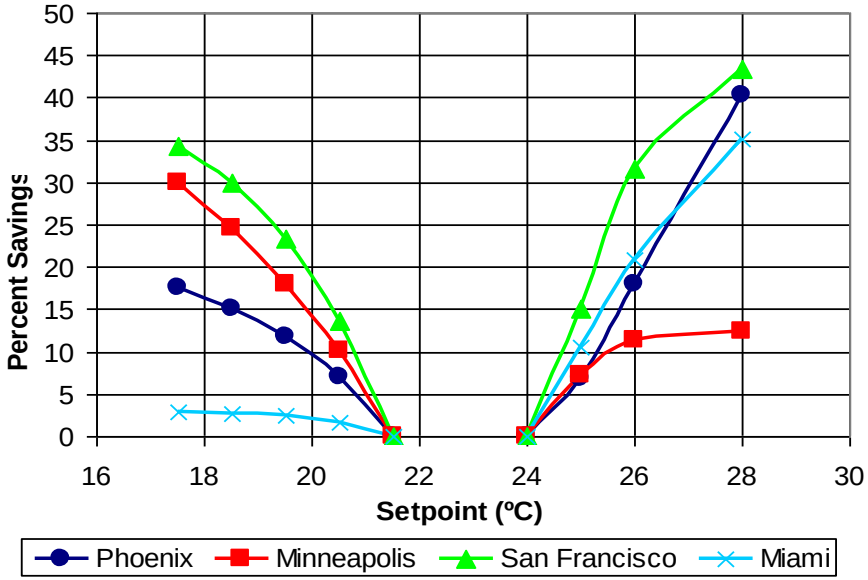
Mitigation: Reduce the dependency on energy consuming technology.
Adaptation: Improve thermal comfort and preferences in warmer and cold environments.

Cooling differently



If we increase air velocity across the skin the thermal comfort threshold temperature is increased by 3-4 °C

Energy savings with broadening indoor air temperature setpoints



Setpoints: **Cooling** **24 to 25 °C** **7 – 15 % saving**
Heating **21.5 to 20.5 °C** **3 – 13 % saving**

Compared to 30% minimum airflow: **17 % saving for 20 % minimum airflow**
27 % saving for 10 % minimum airflow

Zhang, 2009

Urban planning

- Urban areas house over 50 % of the world's population and is only set to increase.
- Physiologists working with urban planners can utilise architecture, urban design and our knowledge of how our bodies work to develop green and cooler spaces which will allow people living in hotter environments to reduce reliance on air conditioning.
- These spaces, in collaboration with areas such as behavioural science, can also promote climate friendly ways of living, such as increasing the use of environmentally friendly modes of transport. This can also benefit other aspects of health.

Mitigation:

(i) Cooler urban spaces which will allow people living in hotter environments to reduce reliance on air conditioning.

(ii) Environment-friendly practices such as sustainable eating and active travel are adopted by the general public, reducing Greenhouse Gas emissions.

Protein nutrition, healthy ageing and climate change: how do we combine the three?

Dr Oliver Witard

The Physiological Society

- Food production = 20–30 % of the UK's greenhouse gas emissions (GHGE).
- 60 % of dietary-induced carbon footprint is from meat.
- GHG emitted at every stage of the food chain.
- Rainforest destruction, for feed or for grazing, removes a major carbon sink.
- Nutritional physiology: how we obtain the nutrients and energy required from food, and how this is linked to health.
- Plant-based protein-rich foods may be more sustainable, but must consider the digestibility of the protein, the essential amino acid profile and the leucine content.
- A multidisciplinary approach combining nutrition, physiology, and mathematical modelling is required.

Mitigation: Develop sustainable proteins that meet nutritional requirements and reduce methane emissions from animal agriculture, reduce the amount of land given over to agriculture and reduce the impact of farming practices on soil.

Policy priorities

- An understanding of the disturbance to physiology that results from the different aspects of climate change is the first step in designing effective mitigations and adaptations, with the focus on mitigations.
- As with many other major societal challenges (e.g. Covid, Long-Covid, healthy ageing), understanding how the body works (physiological) and goes wrong (pathophysiology) is critical for optimising the responses to climate change.
- A multidisciplinary approach (and suitably flexible approaches to funding) will be required to address the health challenges of climate change.
- UK policymakers should take decisions to both keep people here in the UK safe (immediate policy action*) as well as support countries elsewhere through research and funding.
  - *e.g. name and rank heat waves (focusing, co-ordinating, public awareness, behavioural modification).


E&E NEWS

CLIMATE CHANGE

Seville Launches World's First Program to Name and Rank Heat Waves

The launch comes after the hottest first two weeks of June ever recorded in Spain

By Chelsea Harvey, E&E News on June 22, 2022