XLII Antarctic Treaty Consultative Meeting
Prague • Czech Republic • 2019

What Does the Paris Climate Agreement Mean for Antarctic and Southern Ocean Environmental Protection?

Presenter: Steven L Chown

A snapshot recap from the SCAR Lecture at ATCM XL

The Paris Agreement aims to keep global warming well below 2°C - “the safe guardrail for dangerous climate change” identified by the Intergovernmental Panel on Climate Change (IPCC).

The Parties agreed to “pursue efforts to” limit temperature increase to 1.5°C.

The Paris Climate Agreement went into effect in November 2016.

A snapshot recap from the SCAR Lecture at ATCM XL

Revised estimates for year 2100 global sea-level rise

ARTICLE

doi:10.1038/nature17145

Contribution of Antarctica to past and future sea-level rise

Robert M. DeConto[1] & David Pollard[2]

DeConto & Pollard 2016

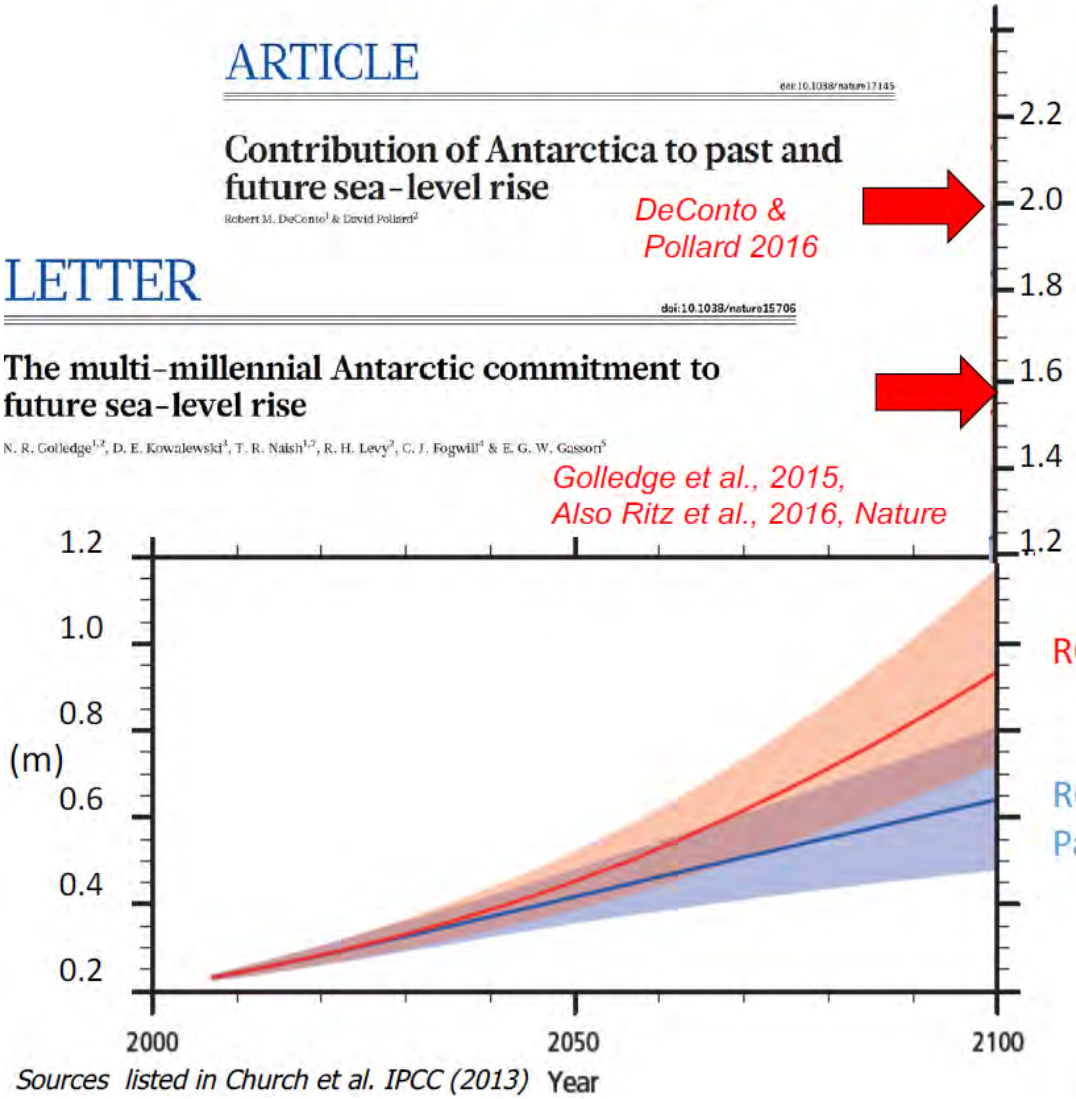
LETTER

doi:10.1038/nature15706

The multi-millennial Antarctic commitment to future sea-level rise

N. R. Golledge[1,2], D. E. Kowalewski[3], T. R. Naish[1,2], R. H. Levy[2], C. J. Fogwill[4] & E. G. W. Gasson[5]

Golledge et al., 2015, Also Ritz et al., 2016, Nature



Sources listed in Church et al. IPCC (2013)

RCP 8.5 high-emissions pathway, based on new paleo-calibrated ice sheet model simulations compared with the "likely" (66%) range from the IPCC 5th Assessment Report.

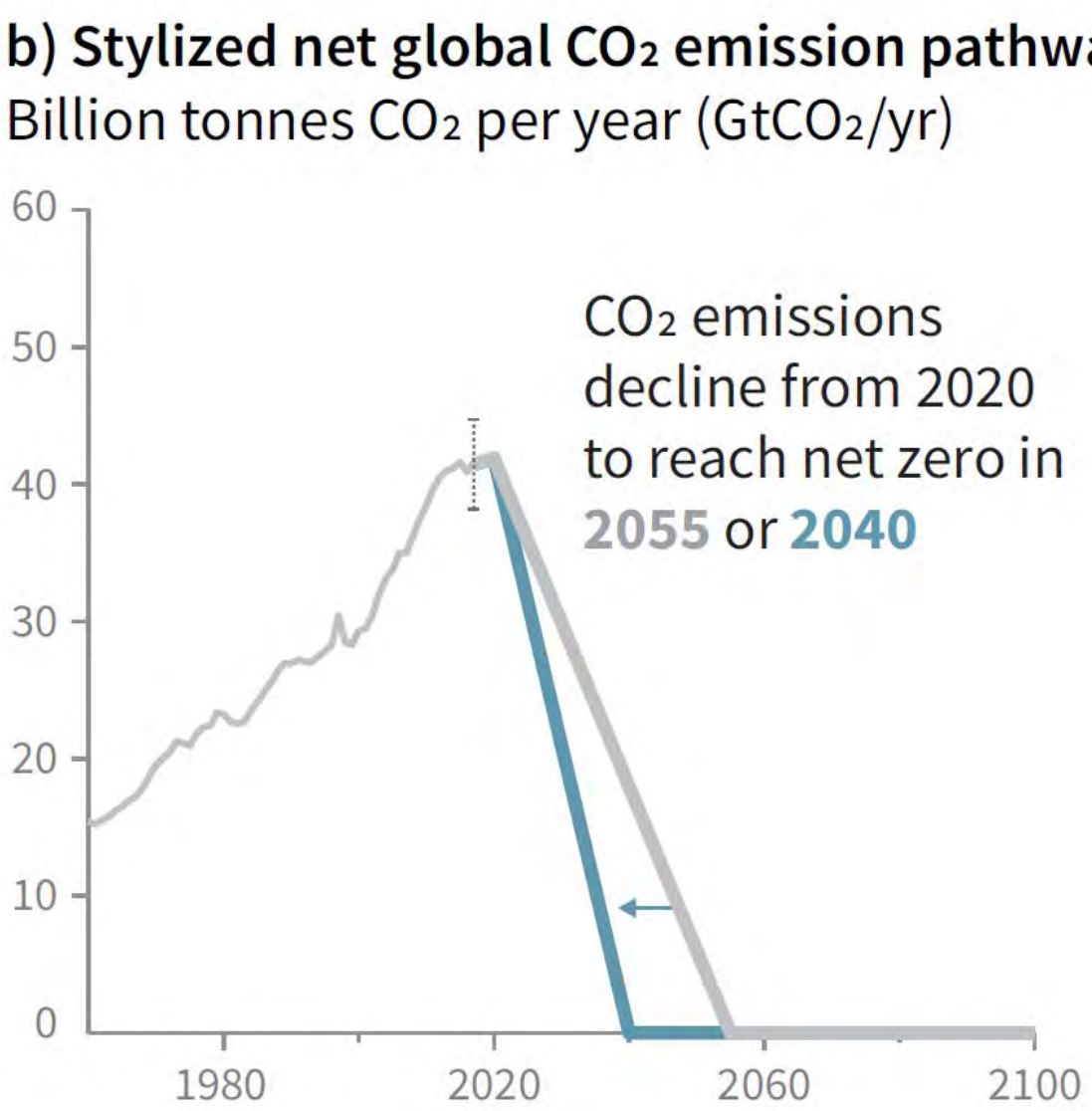
Business as usual

RCP 8.5

RCP 2.6
Paris target

Ambition

Developments since ATCM XL
IPCC Special Report on Global Warming of 1.5°C



https://www.ipcc.ch/sr15/

Developments since ATCM XL
What are global emissions?

2018: 33.1 Gt CO_2

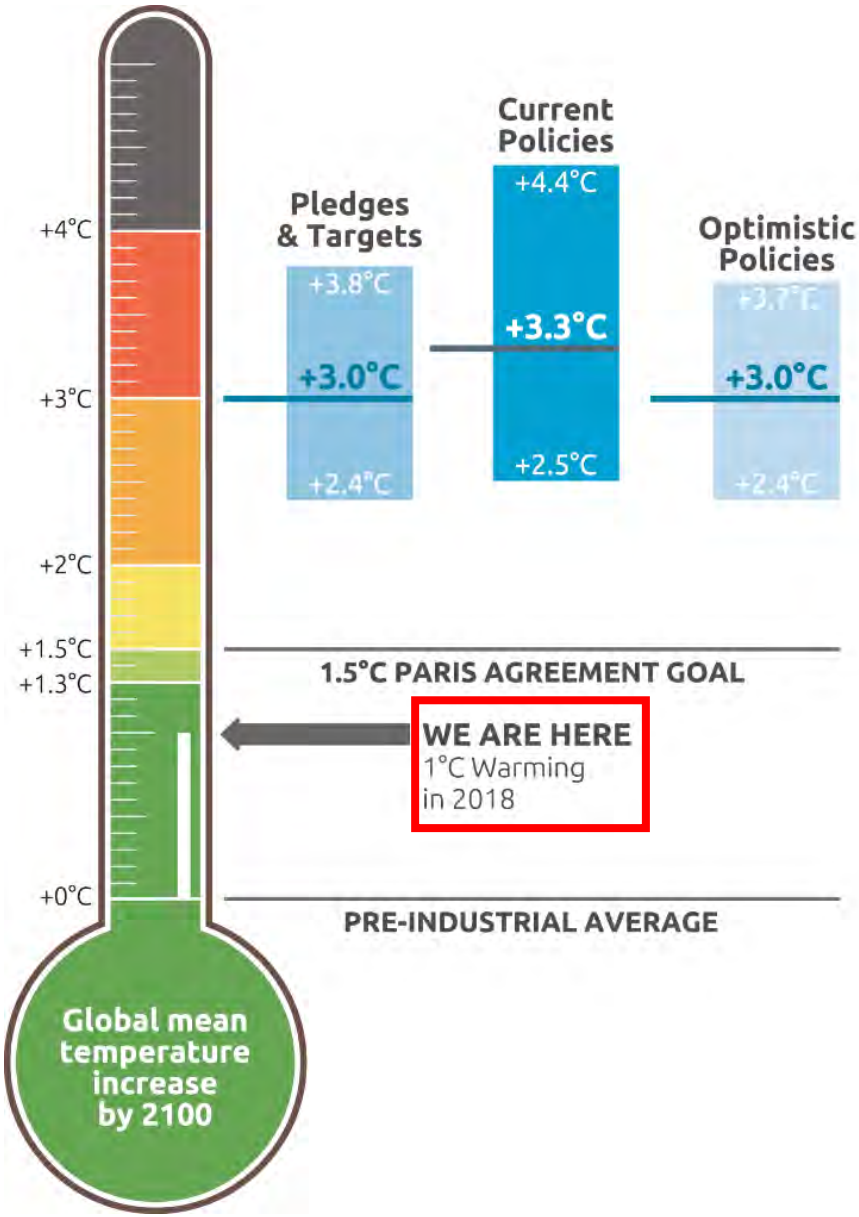
Table 1.5 ▷ World energy-related CO_2 emissions by fuel and scenario (Mt)

			New Policies		Current Policies		Sustainable Development	
	2000	2017	2025	2040	2025	2040	2025	2040
Coal	8 951	14 448	14 284	14 170	15 207	17 930	11 335	3 855
Oil	9 620	11 339	11 862	11 980	12 303	13 984	10 657	6 886
Gas	4 551	6 794	7 757	9 731	7 945	10 561	7 543	6 906
Total CO_2	23 123	32 580	33 902	35 881	35 454	42 475	29 535	17 647

Note: Mt = million tonnes.

SUSTAINABLE DEVELOPMENT GOALS

Developments since ATCM XL – Implications



Climate Action Tracker

CAT warming projections

Global temperature increase by 2100

December 2018 Update

Developments since ATCM XL – Implications

ARTICLE 21 JUNE 2018 | VOL 558 | NATURE | 383
https://doi.org/10.1038/s41586-018-0212-1

Antarctic ice shelf disintegration triggered by sea ice loss and ocean swell

Robert A. Massom[1,2*], Theodore A. Scambos[3], Luke G. Bennetts[4], Phillip Reid[2,5], Vernon A. Squire[6] & Sharon E. Stammerjohn[7]

ARTICLE 7 FEBRUARY 2019 | VOL 566 | NATURE | 65
https://doi.org/10.1038/s41586-019-0889-9

Global environmental consequences of twenty-first-century ice-sheet melt

Nicholas R. Golledge[1,2*], Elizabeth D. Keller[2], Natalya Gomez[3], Kaitlin A. Naughten[4], Jorge Bernales[5], Luke D. Trusel[6] & Tamsin L. Edwards[7]

Developments since ATCM XL – Implications

Ice sheet contributions to future sea-level rise from structured expert judgment

Jonathan L. Bamber[a,1], Michael Oppenheimer[b,c], Robert E. Kopp[d,e], Willy P. Aspinall[f,g], and Roger M. Cooke[h,i]

PNAS | June 4, 2019 | vol. 116 | no. 23 | 11195–11200

"We find that since AR5, expert uncertainty has grown, in particular because of uncertain ice dynamics effects."

"Our findings support the use of scenarios of 21st century global total Sea Level Rise exceeding 2 m for planning purposes."

Developments since ATCM XL – Approaches

Sustained and coordinated research efforts

Examples

- *Thwaites Glacier and Totten Glacier Programs*
- *International Ocean Discovery Program – Antarctic*
- *SCAR's Proposed Antarctic Ice Sheet Dynamics and Global Sea Level Scientific Research Program*

Developments since ATCM XL – Approaches

Enhanced communication of the implications to global decision-makers – joint action

Developments since ATCM XL – Impacts

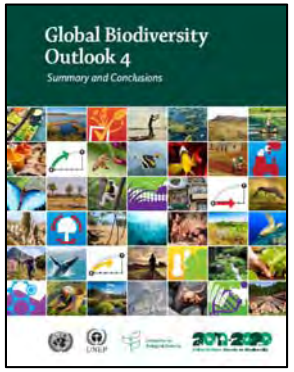
ipbes
Science and Policy for People and Nature

Global Assessment Report on Biodiversity and Ecosystem Services

The only mention of Antarctica and/or the Southern Ocean (summary)

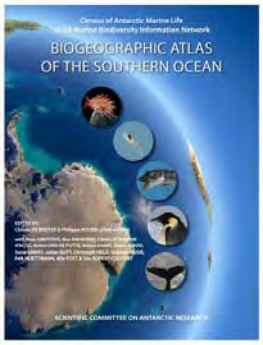
Ocean mining, while relatively small, has expanded since 1981 to ~ 6,500 offshore oil and gas installation worldwide in 53 countries (60% in the Gulf of Mexico by 2003) and likely will expand into the Arctic and Antarctic regions as the ice melts {2.1.11}.

Little discussion here either

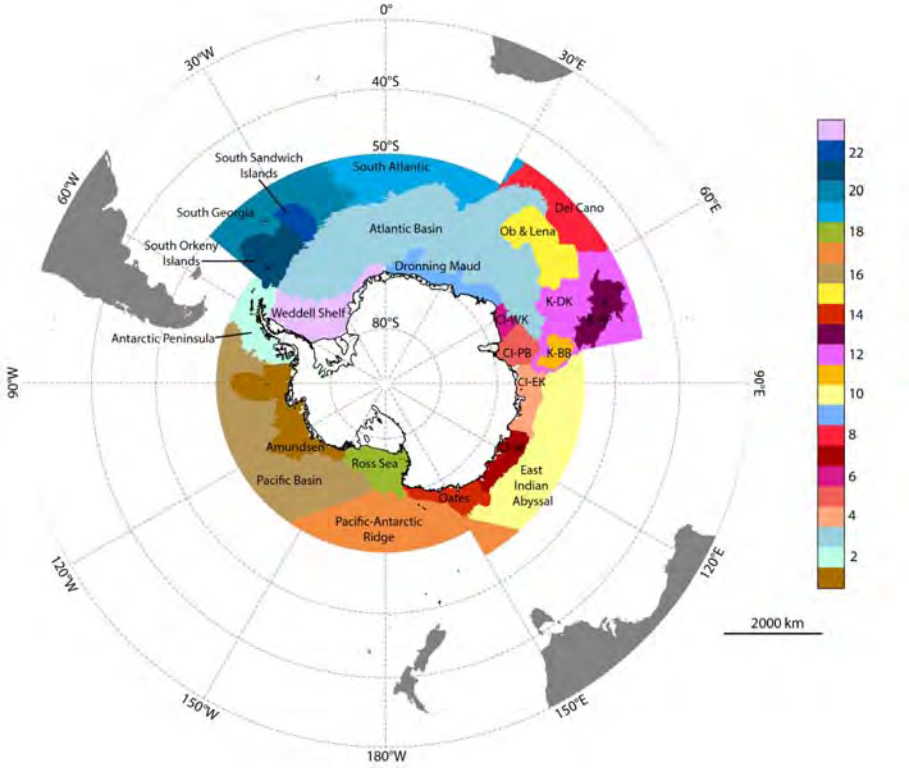


Are Antarctic and Southern Ocean Environments Neither Diverse nor Globally Important?

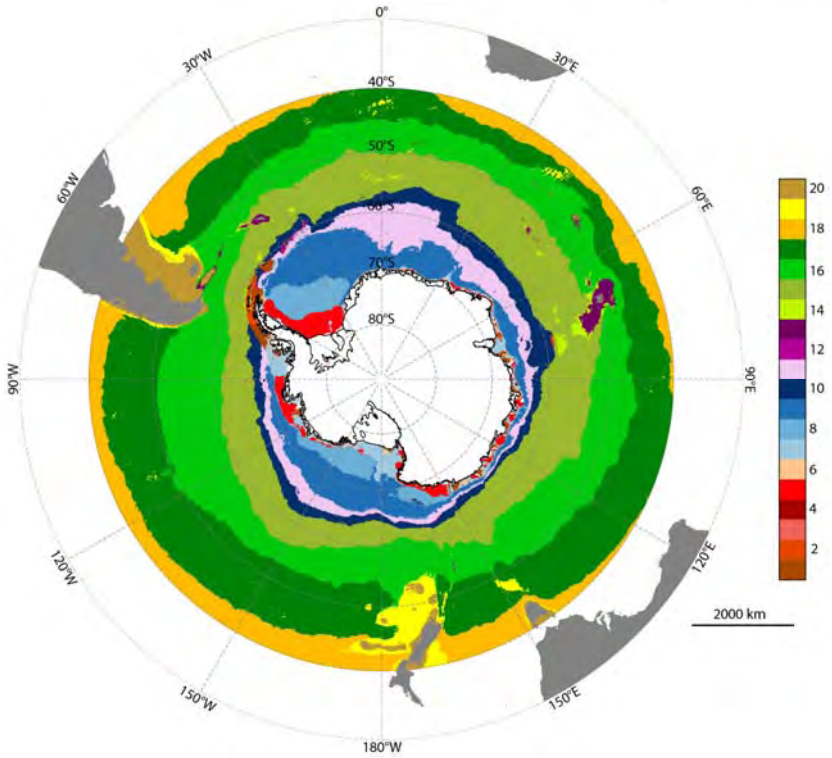
Southern Ocean Living Environments
Diverse, Spatially Structured



Benthic ecoregions



Pelagic ecoregions



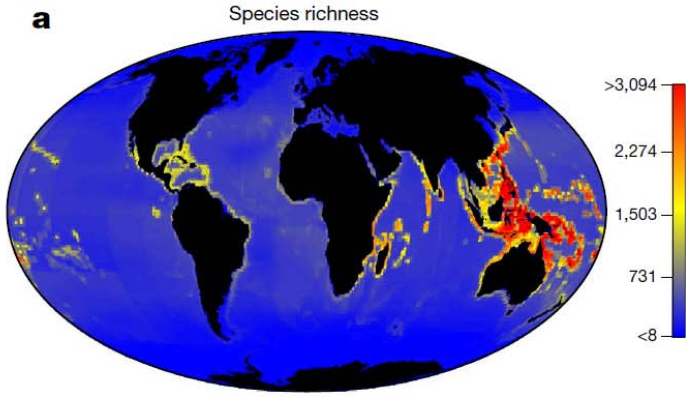
Southern Ocean Living Environments

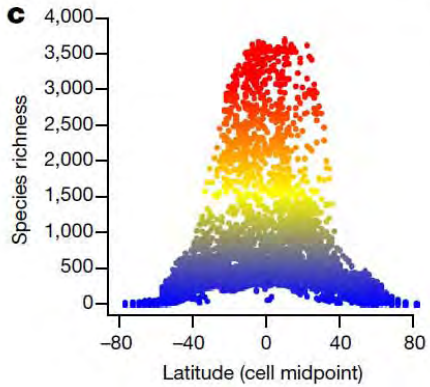
LETTER | NATURE | VOL 559 | 19 JULY 2018

https://doi.org/10.1038/s41586-018-0273-1

An inverse latitudinal gradient in speciation rate for marine fishes

Daniel L. Rabosky[1,10]*, Jonathan Chang[2,10], Pascal O. Title[1,10], Peter F. Cowman[3,4], Lauren Sallan[5], Matt Friedman[6], Kristin Kaschner[7], Cristina Garilao[8], Thomas J. Near[3], Marta Coll[9] & Michael E. Alfaro[2,10]





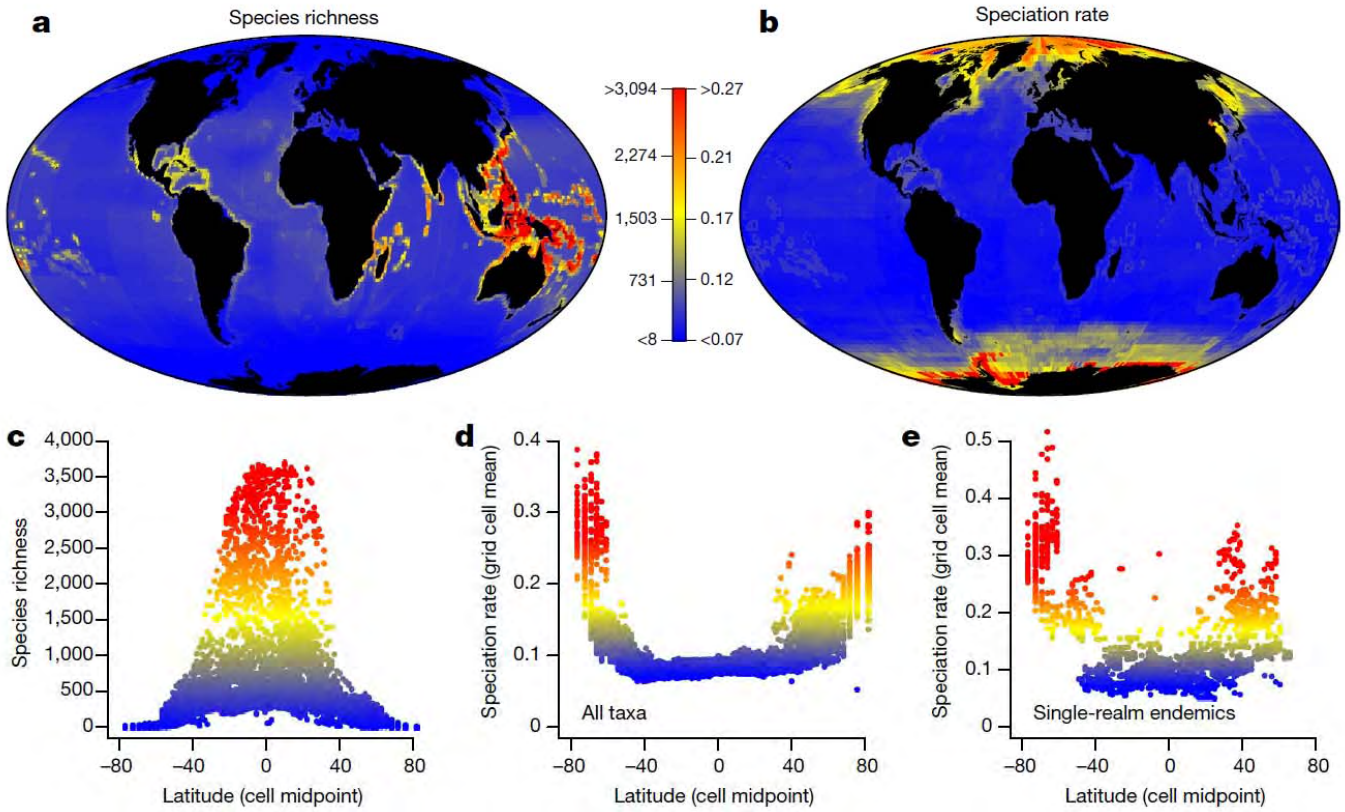
LSA ECOLOGY AND EVOLUTIONARY BIOLOGY
UNIVERSITY OF MICHIGAN

Southern Ocean Living Environments
A Cradle of Diversity/An Engine for Variety

LETTER | NATURE | VOL 559 | 19 JULY 2018
https://doi.org/10.1038/s41586-018-0273-1

An inverse latitudinal gradient in speciation rate for marine fishes

Daniel L. Rabosky[1,10]*, Jonathan Chang[2,10], Pascal O. Title[1,10], Peter F. Cowman[3,4], Lauren Sallan[5], Matt Friedman[6], Kristin Kaschner[7], Cristina Garilao[8], Thomas J. Near[3], Marta Coll[9] & Michael E. Alfaro[2,10]



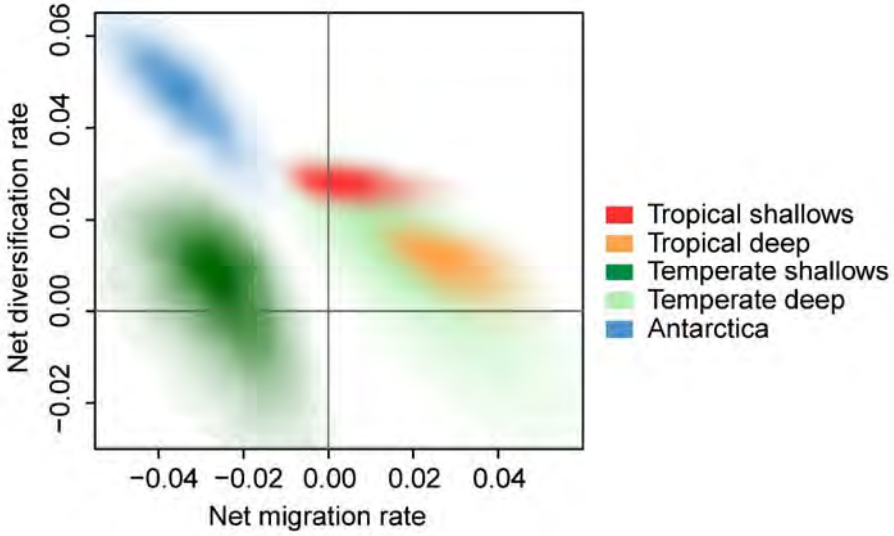
Southern Ocean Living Environments
A Cradle of Diversity/An Engine for Variety

LETTER | NATURE | VOL 565 | 31 JANUARY 2019
https://doi.org/10.1038/s41586-019-0886-z

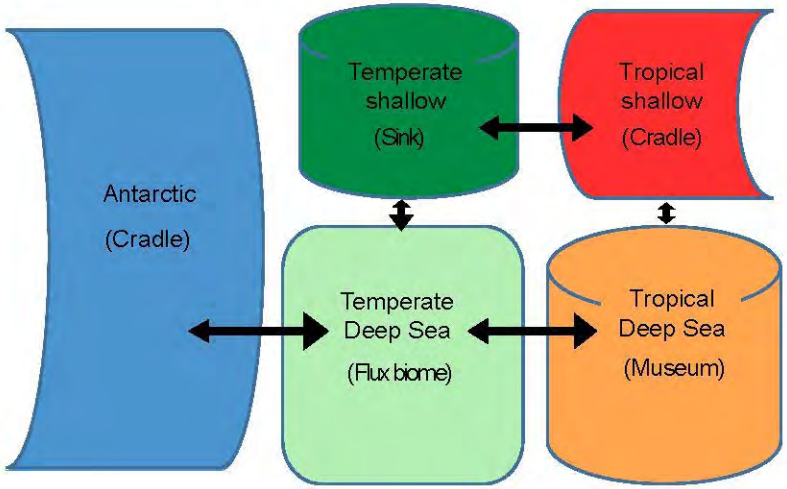
Contrasting processes drive ophiuroid phylodiversity across shallow and deep seafloors

Timothy D. O'Hara[1]*, Andrew F. Hugall[1], Skipton N. C. Woolley[1,2], Guadalupe Bribiesca-Contreras[1,3] & Nicholas J. Bax[2,4]

How fast do new species arise

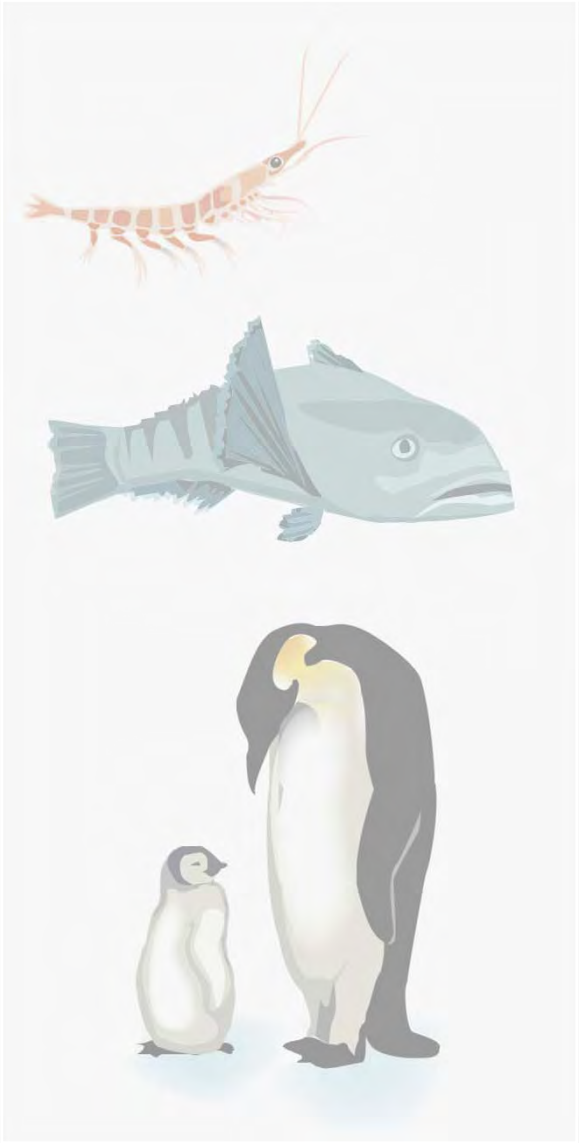


How fast do species move elsewhere



Southern Ocean Living Environments Protecting Them

Image to follow



Southern Ocean Living Environments Protecting Them

SCAR: Retrospective Analysis of Antarctic Tracking Data

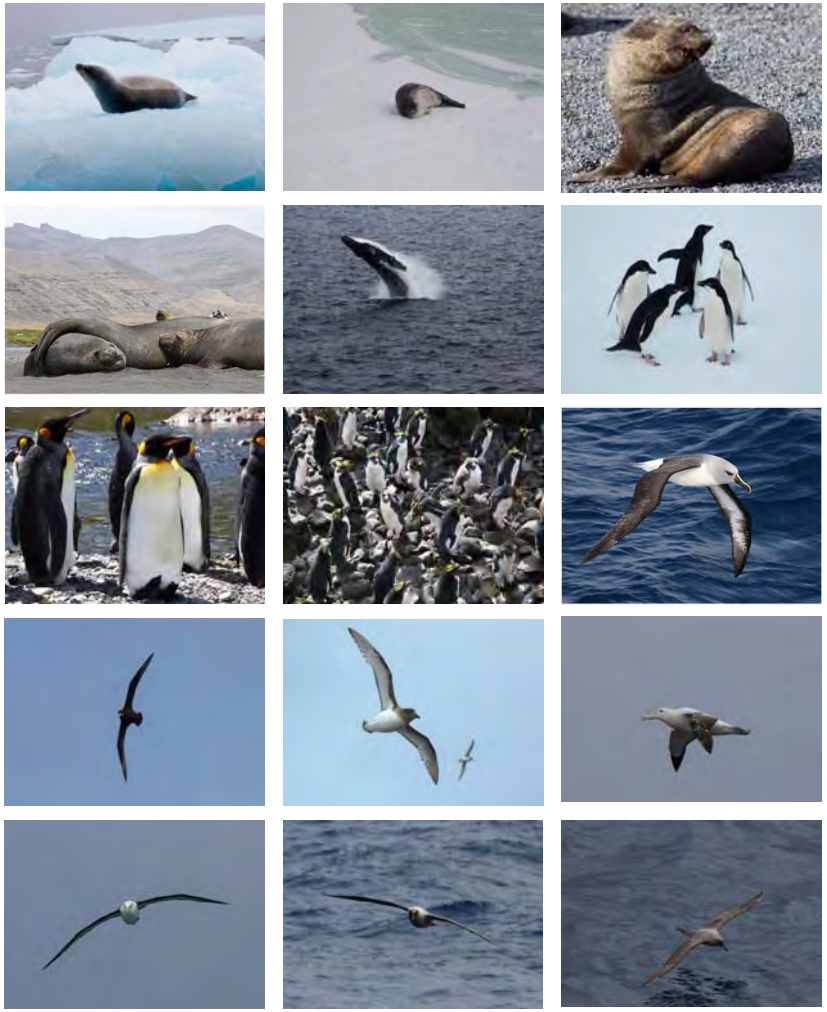
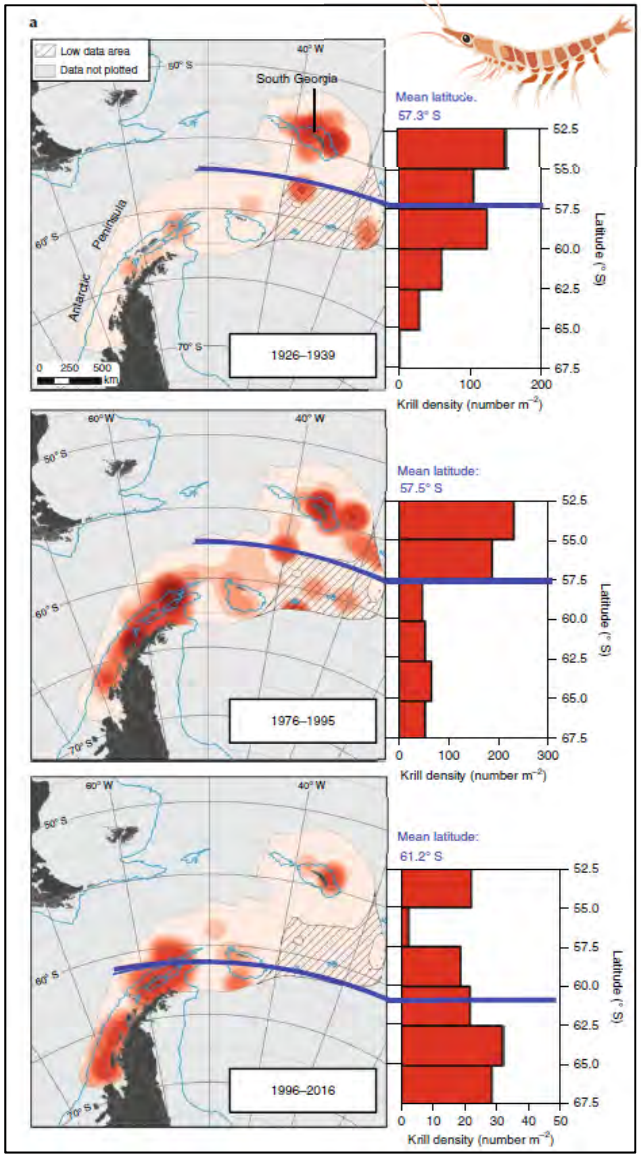


Image to follow

Hindell *et al*., in revision

Southern Ocean Living Environments
Do We Have Evidence for Change?



LETTERS
https://doi.org/10.1038/s41558-018-0370-z
nature climate change

Krill (*Euphausia superba*) distribution contracts southward during rapid regional warming

Angus Atkinson[1,11]*, Simeon L. Hill[2,11]*, Evgeny A. Pakhomov[3,4,5], Volker Siegel[6], Christian S. Reiss[7], Valerie J. Loeb[8], Deborah K. Steinberg[9], Katrin Schmidt[10], Geraint A. Tarling[2], Laura Gerrish[2] and Sévrine F. Sailley[1]

Southern Ocean Living Environments Challenges and Change

- Changes in abundance

  challenges to ecosystem management

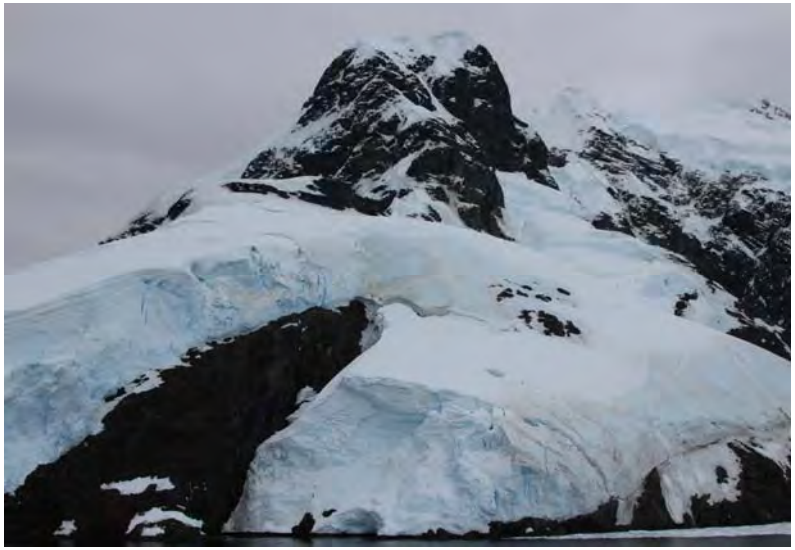
- Winners and losers from change

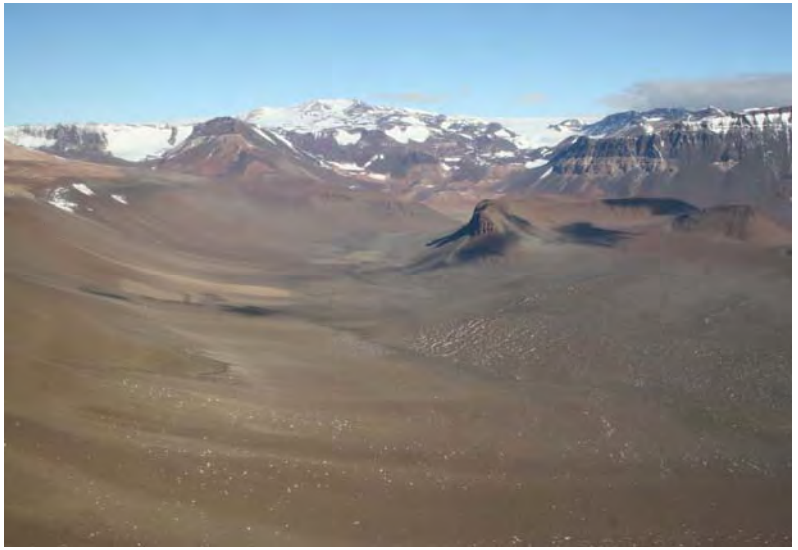
  unknown ecosystem modification

- Lowest capacities to tolerate warming

  extinction

Antarctic Living Environments On Land





Antarctic Living Environments Diverse in Unusual Ways

NATURE REVIEWS | MICROBIOLOGY

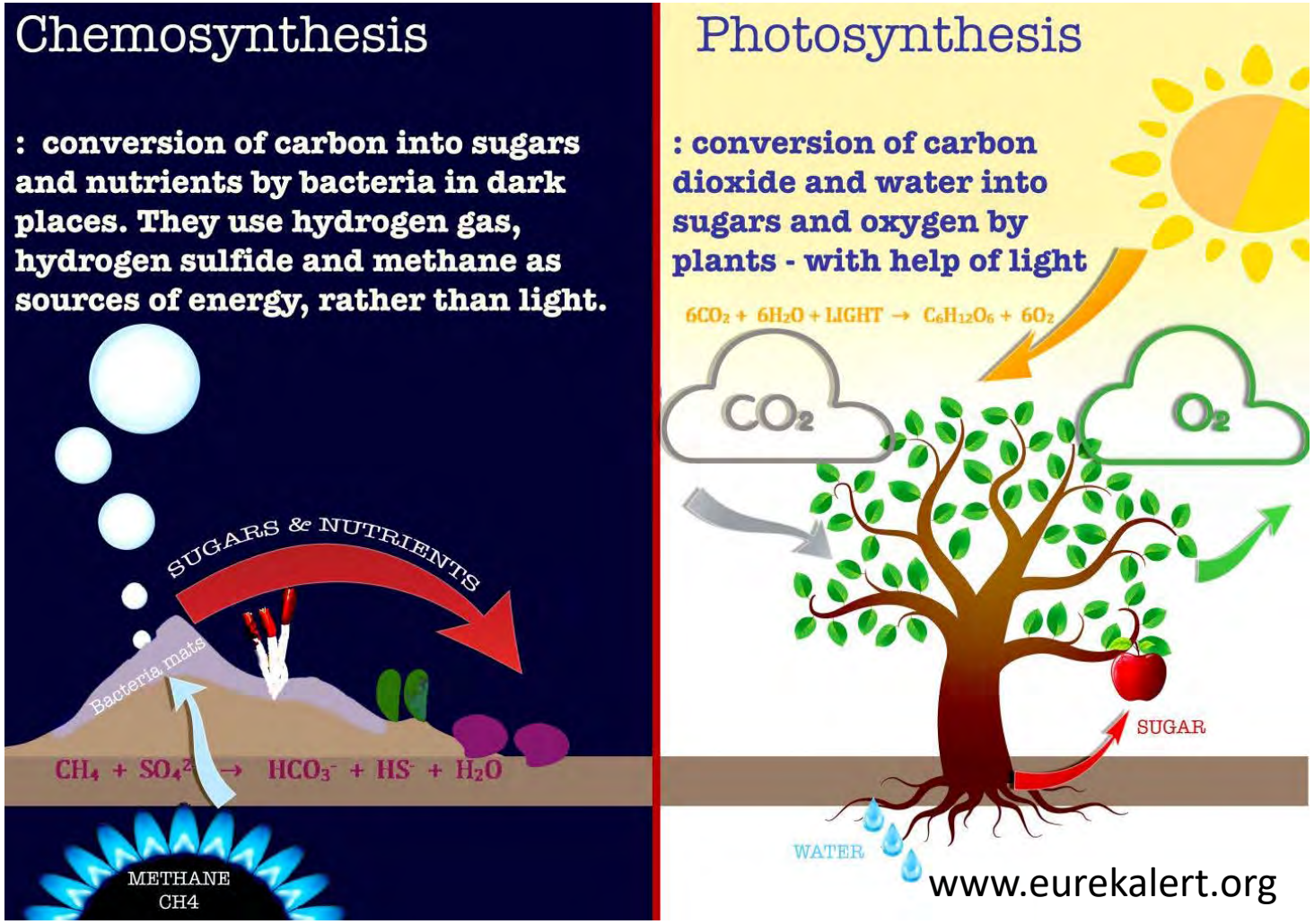
Microbial ecology of Antarctic aquatic systems

Ricardo Cavicchioli

On the rocks: the microbiology of Antarctic Dry Valley soils

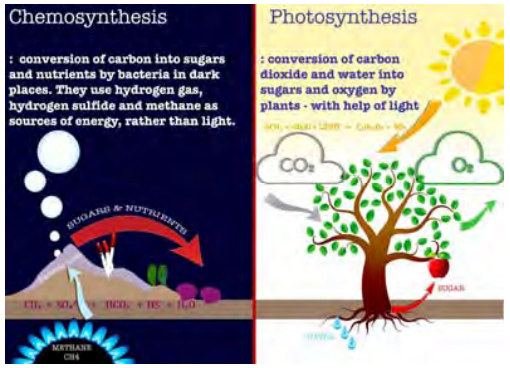
S. Craig Cary[*‡], *Ian R. McDonald*[*], *John E. Barrett*[§] *and Don A. Cowan*[||]

Antarctic Living Environments Diverse in Unusual Ways



www.eurekalert.org

Antarctic Living Environments Diverse in Unusual Ways



www.eurekalert.org

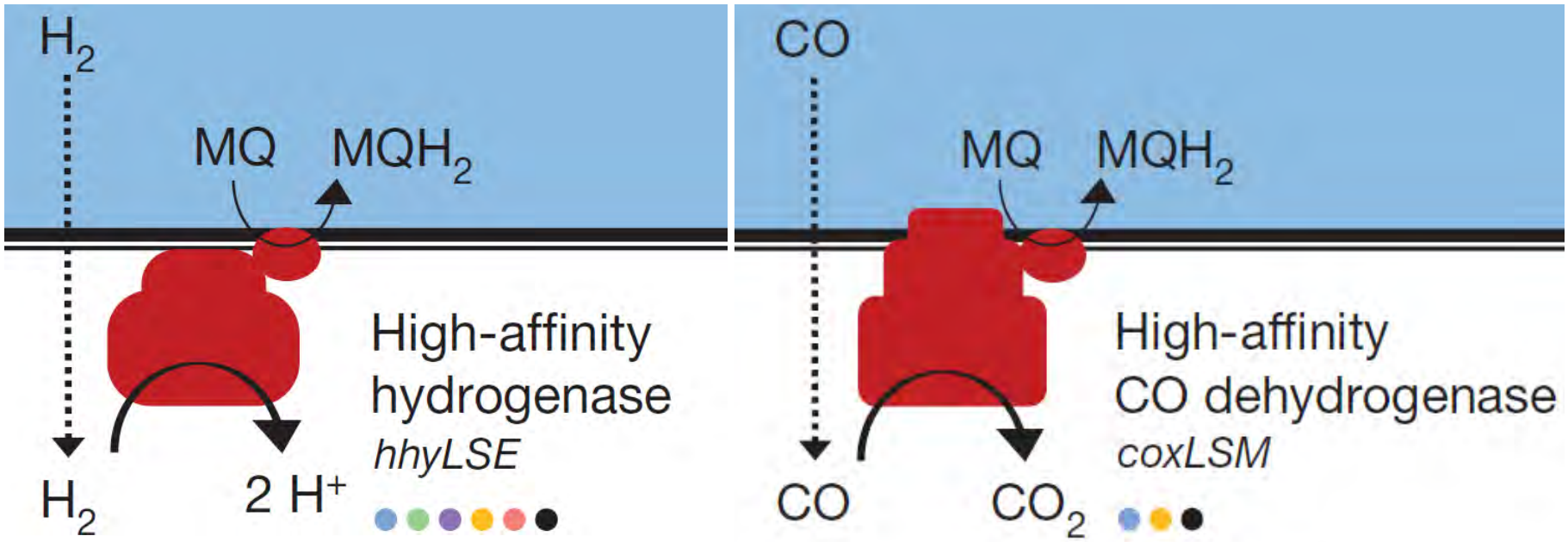
LETTER

OPEN

doi:10.1038/nature25014

Atmospheric trace gases support primary production in Antarctic desert surface soil

Mukan Ji[1]*, Chris Greening[2]*, Inka Vanwonterghem[3], Carlo R. Carere[4], Sean K. Bay[2], Jason A. Steen[3], Kate Montgomery[1], Thomas Lines[2], John Beardall[2], Josie van Dorst[1], Ian Snape[5], Matthew B. Stott[4], Philip Hugenholtz[3] & Belinda C. Ferrari[1]



Antarctic Living Environments Already Changing

nature climate change

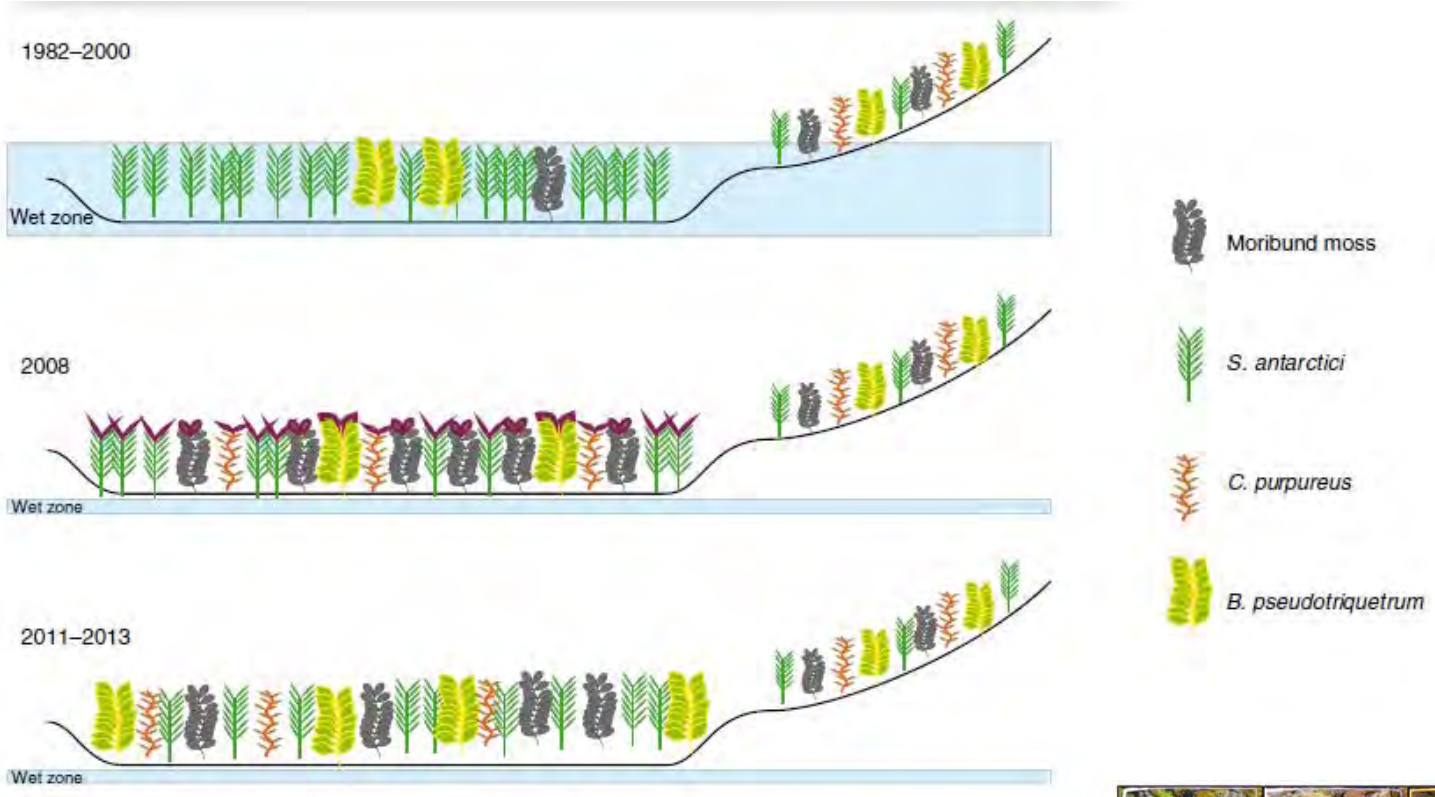
LETTERS

https://doi.org/10.1038/s41558-018-0280-0

Rapid change in East Antarctic terrestrial vegetation in response to regional drying

Sharon A. Robinson[1,2,8*], Diana H. King[1,8], Jessica Bramley-Alves[1,8], Melinda J. Waterman[1,8], Michael B. Ashcroft[1,8], Jane Wasley[1,4,8], Johanna D. Turnbull[1], Rebecca E. Miller[1,5], Ellen Ryan-Colton[1,6], Taylor Benny[1], Kathryn Mullany[1], Laurence J. Clarke[1,4,7], Linda A. Barry[3] and Quan Hua[3]

Drought-tolerant mosses replacing moisture-dependent ones in East Antarctica



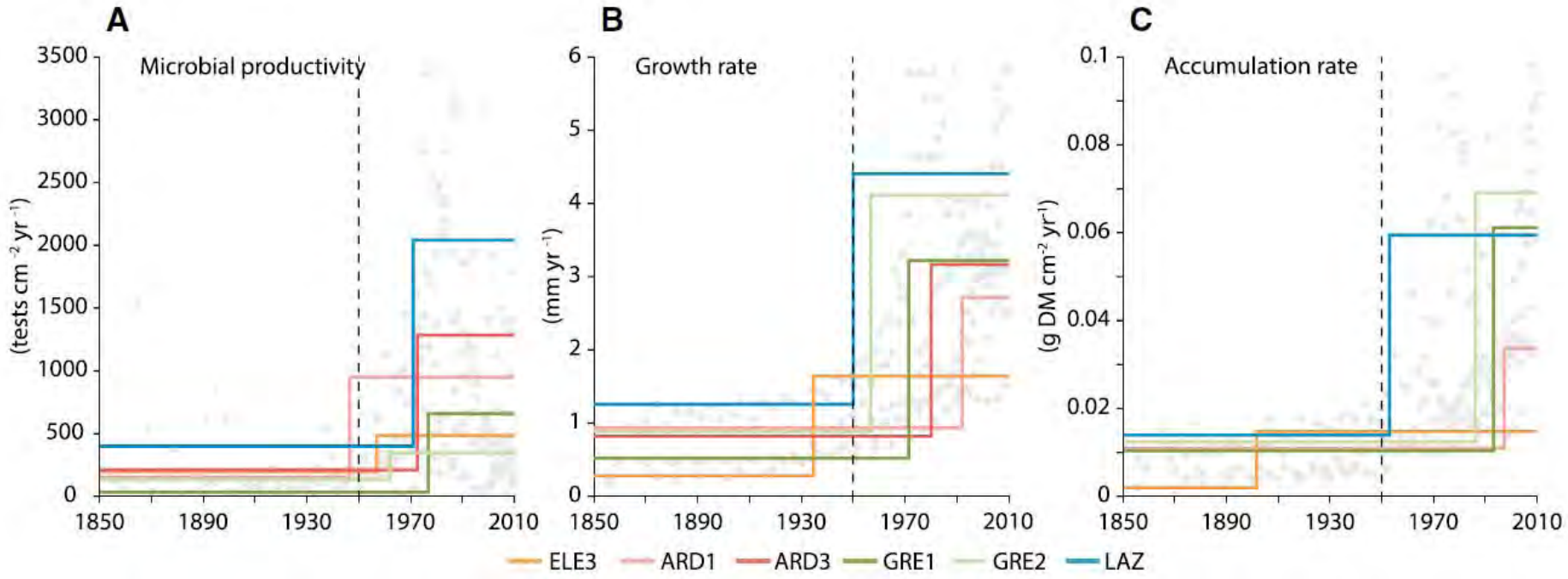
Antarctic Living Environments Already Changing West and East

Current Biology
Report

Widespread Biological Response to Rapid Warming on the Antarctic Peninsula

Matthew J. Amesbury,[1,5,*] Thomas P. Roland,[1] Jessica Royles,[2,3] Dominic A. Hodgson,[3,4] Peter Convey,[3] Howard Griffiths,[2] and Dan J. Charman[1]

Biological rates have increased hugely



Antarctic Living Environments Already Changing in the Dry Valleys

ARTICLES
DOI: 10.1038/s41559-017-0253-0

nature ecology & evolution

Decadal ecosystem response to an anomalous melt season in a polar desert in Antarctica

Michael N. Gooseff[1*], John E. Barrett[2], Byron J. Adams[3], Peter T. Doran[4], Andrew G. Fountain[5], W. Berry Lyons[6], Diane M. McKnight[1], John C. Priscu[7], Eric R. Sokol[1], Cristina Takacs-Vesbach[8], Martijn L. Vandegehuchte[9,10,11], Ross A. Virginia[12] and Diana H. Wall[9]

Antarctic Living Environments
Non-Native Species Increasing Too

Polar Biology (2019) 42:1047–1051
https://doi.org/10.1007/s00300-019-02490-8

SHORT NOTE

Check for updates

The importance of long-term surveys on species introductions in Maritime Antarctica: first detection of *Ceratophysella succinea* (Collembola: Hypogastruridae)

Natalia Enríquez[1] · Luis R. Pertierra[2] · Pablo Tejedo[3] · Javier Benayas[3] · Penelope Greenslade[4] · María José Luciáñez[1]

IP 120

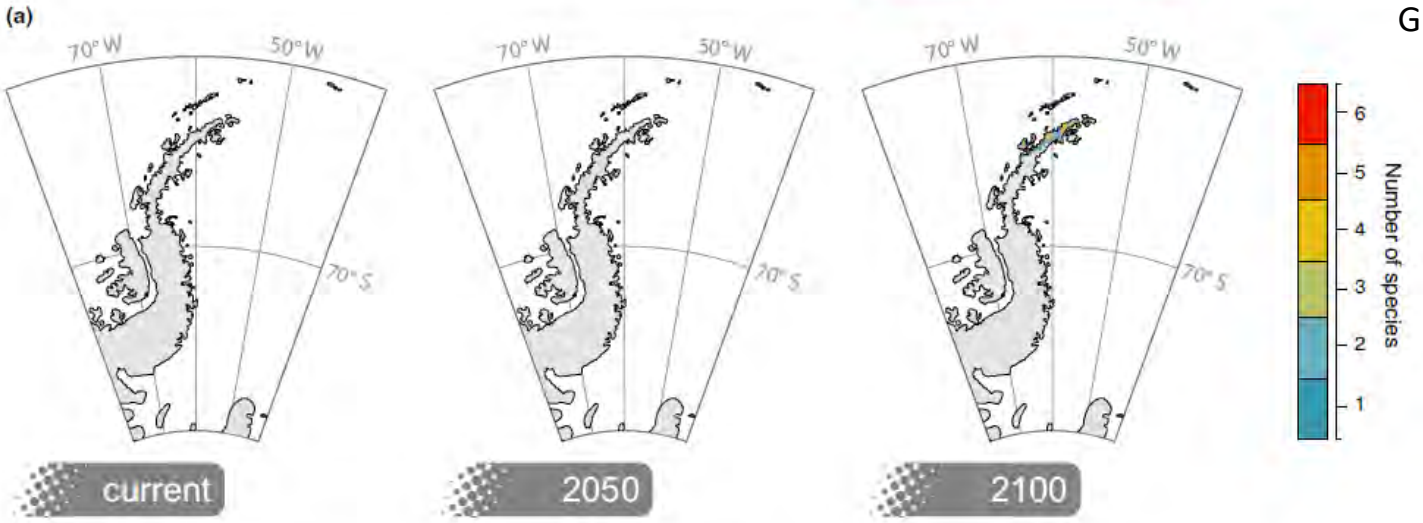
ENG

Agenda Item: CEP 10a
Presented by: Uruguay, Korea (ROK), Argentina, Brazil, Chile, China, Germany, Russian Federation
Original: English
Submitted: 31/5/2019

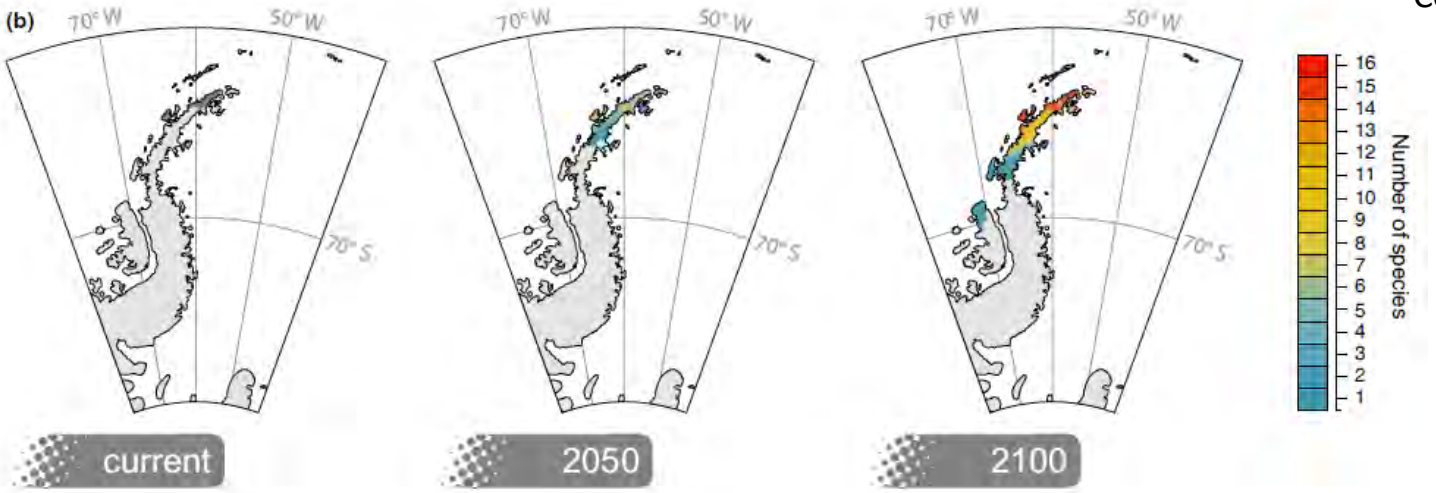
Report of the 2018/2019 summer campaign of the joint monitoring programme of non-native flies in King George Island / Isla 25 de Mayo

Antarctic Living Environments
Non-Native Species: Expect More Change

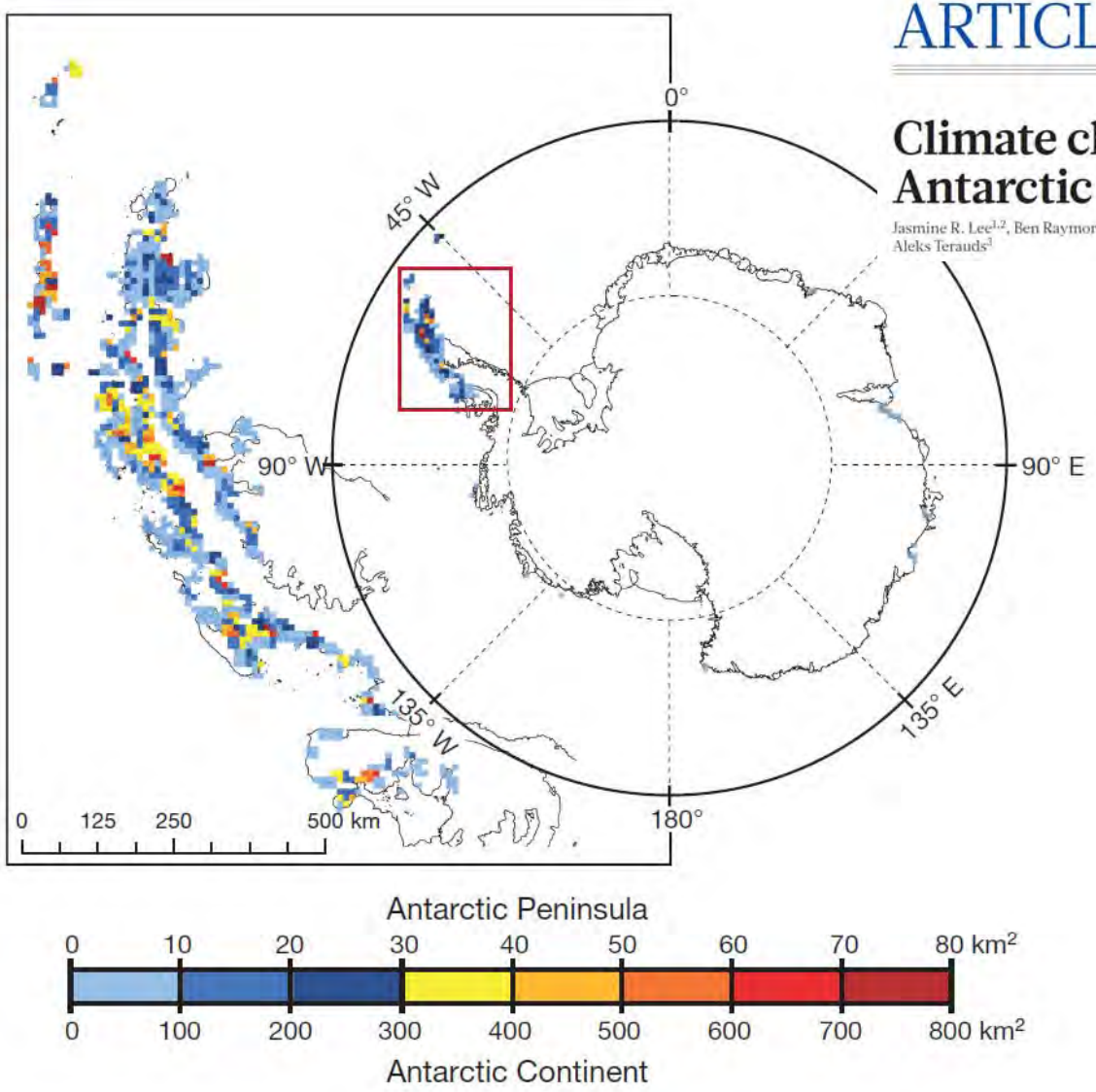
Globally worst invasives



Cold climate invasives



Antarctic Living Environments
Ice-Free Areas Expand



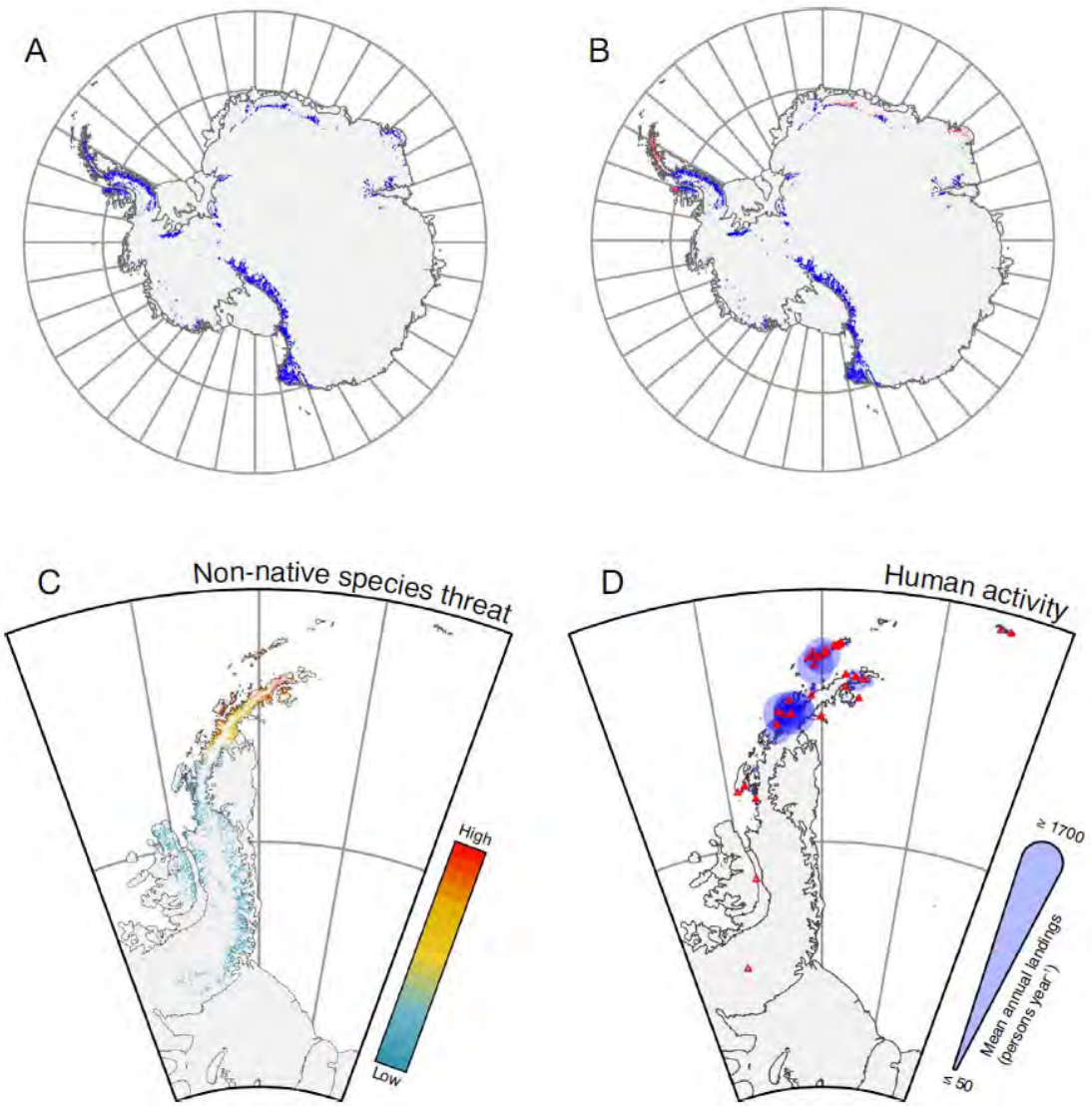
ARTICLE

doi:10.1038/nature22996

Climate change drives expansion of Antarctic ice-free habitat

Jasmine R. Lee[1,2], Ben Raymond[3,4,5], Thomas J. Bracegirdle[6], Iadine Chadès[2,7], Richard A. Fuller[1], Justine D. Shaw[1,7] & Aleks Terauds[3]

Antarctic Living Environments
Non-Native Species: Ice-Free Areas Expand Ranges



Duffy & Lee 2019 *Biol Conserv*.

Antarctic Living Environments
Climate Change Impacts are Profound

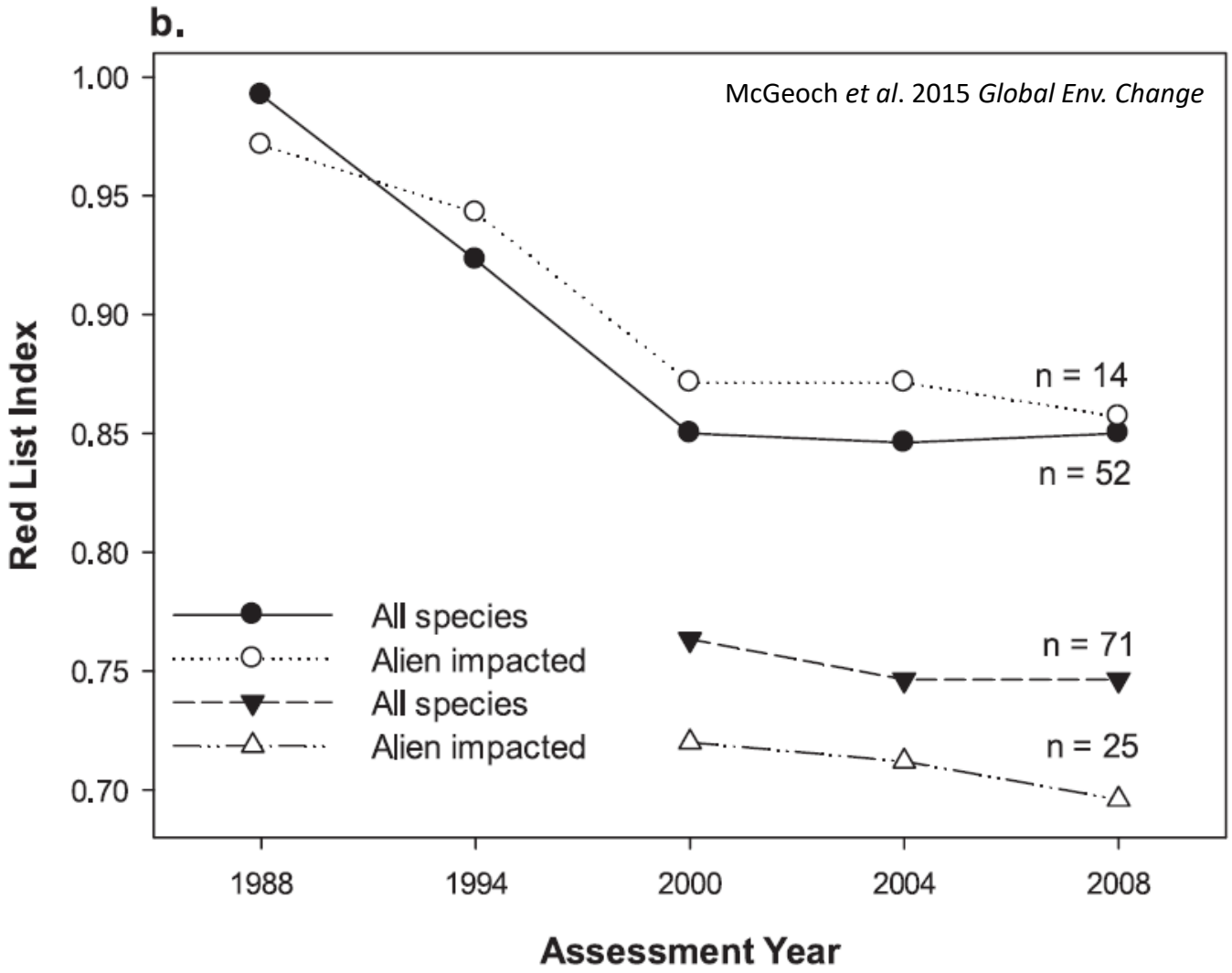
Antarctic Science 28(2), 73–80 (2016) © Antarctic Science Ltd 2015 doi:10.1017/S0954102015000486

'Scalping' of albatross fledglings by introduced mice spreads rapidly at Marion Island

BEN J. DILLEY, STEFAN SCHOOMBIE, JANINE SCHOOMBIE and PETER G. RYAN

Images to follow

Antarctic Living Environments
IUCN Red List Index Antarctic Bird Species



Antarctic Living Environments Challenges and Change

- Rapidly changing species and ecosystems
  challenges to ecosystem and ASPA management

- Growing invasive non-native species numbers and impacts
  abundance decline, ecosystem change

- Changing intrinsic properties of Antarctica's ecosystems
  compromised scientific values

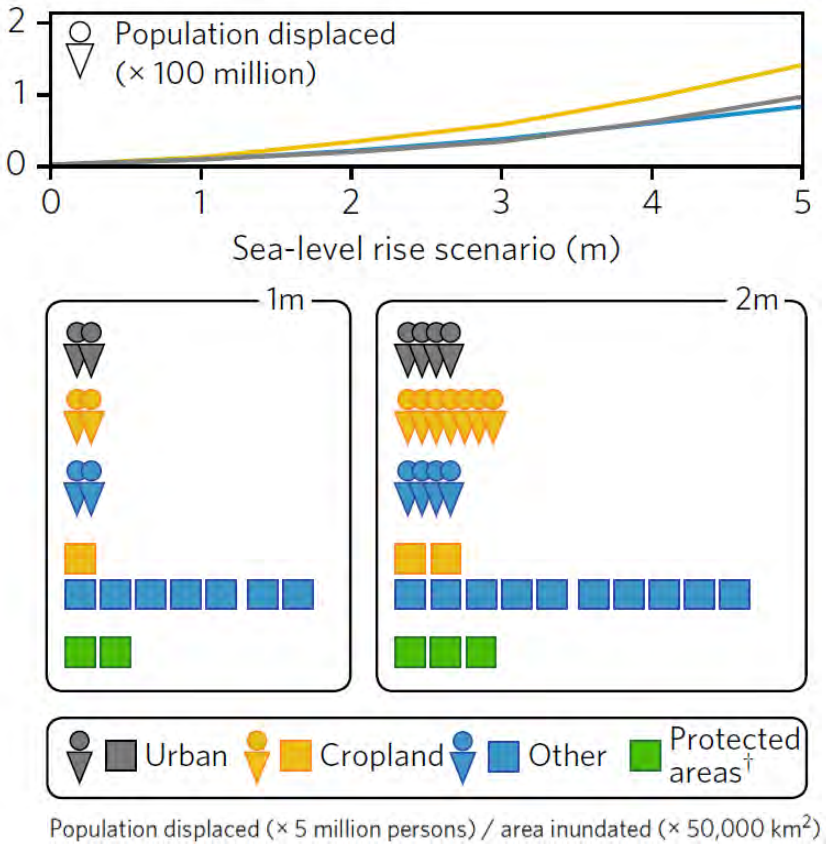
Antarctic Environments Global Significance

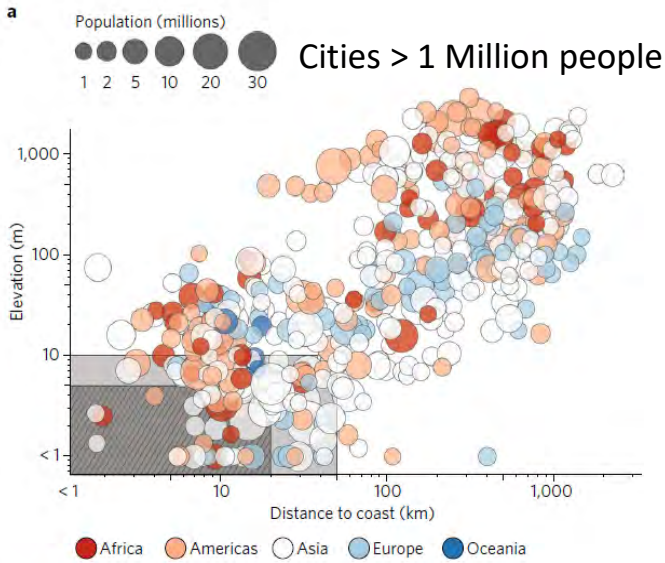
Image: NASA Black Marble

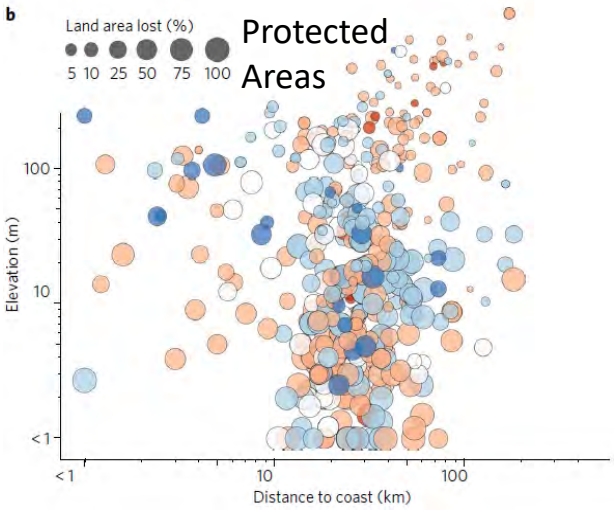
Antarctic Ice Sheets and Life Elsewhere
Cities > 1 M and Protected Areas Globally

Bamber *et al*. 2019 PNAS

Our findings support the use of scenarios of 21st century global total Sea Level Rise exceeding 2 m for planning purposes.







Chown & Duffy 2017 *Nature Ecology & Evolution*

To Conclude: What the Science Says

- Not reducing greenhouse gas emissions to zero by 2050 will mean widespread Antarctic transformation
- Antarctic and Southern Ocean environments contribute to the maintenance of life globally in important and unexpected ways
- The window for action is 13 to 32 years: success depends on urgent global collaboration – the Paris Agreement is critical

The Paris Agreement and Antarctic Living Environments

Image to follow

Thanks to

MONASH University

SCAR community

Angus Atkinson
Helena Baird
Elizabeth Botte
Cassandra Brooks
Grant Duffy
Mark Hindell
Jasmine Lee
Jennifer Lee
Melodie McGeoch
Tim O'Hara
Chandrika Nath
Dan Rabosky
Sharon Robinson
Yan Ropert-Coudert
Peter Ryan
Alek Terauds
John Weller
David Walton†

Australian Government
Department of the Environment and Energy
Australian Antarctic Division

AUSTRALIAN ANTARCTIC PROGRAM