Biological Resilience - Seagrasses

Carbon Storage

Paul Lavery
Edith Cowan University
Centre for Marine Ecosystems Research
p.lavery@ecu.edu.au

ARTICLES
https://doi.org/10.1038/s41558-018-0096-y
nature climate change

A marine heatwave drives massive losses from the world's largest seagrass carbon stocks

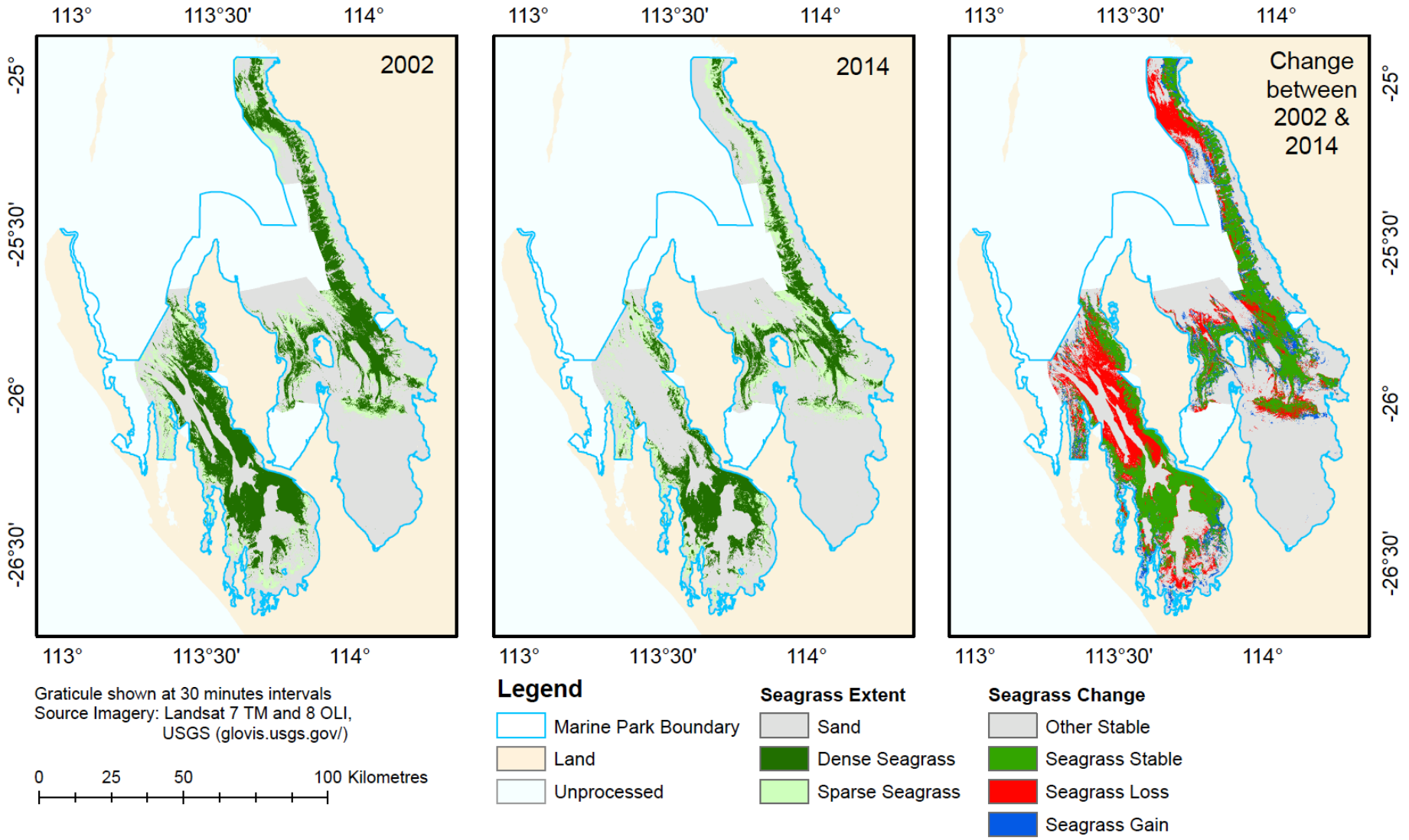
A. Arias-Ortiz[1*], O. Serrano[2,3], P. Masqué[1,2,3], P. S. Lavery[2,4], U. Mueller[2], G. A. Kendrick[3,5], M. Rozaimi[2,6], A. Esteban[2], J. W. Fourqurean[5,7], N. Marbà[8], M. A. Mateo[2,4], K. Murray[9], M. J. Rule[3,9] and C. M. Duarte[8,10]

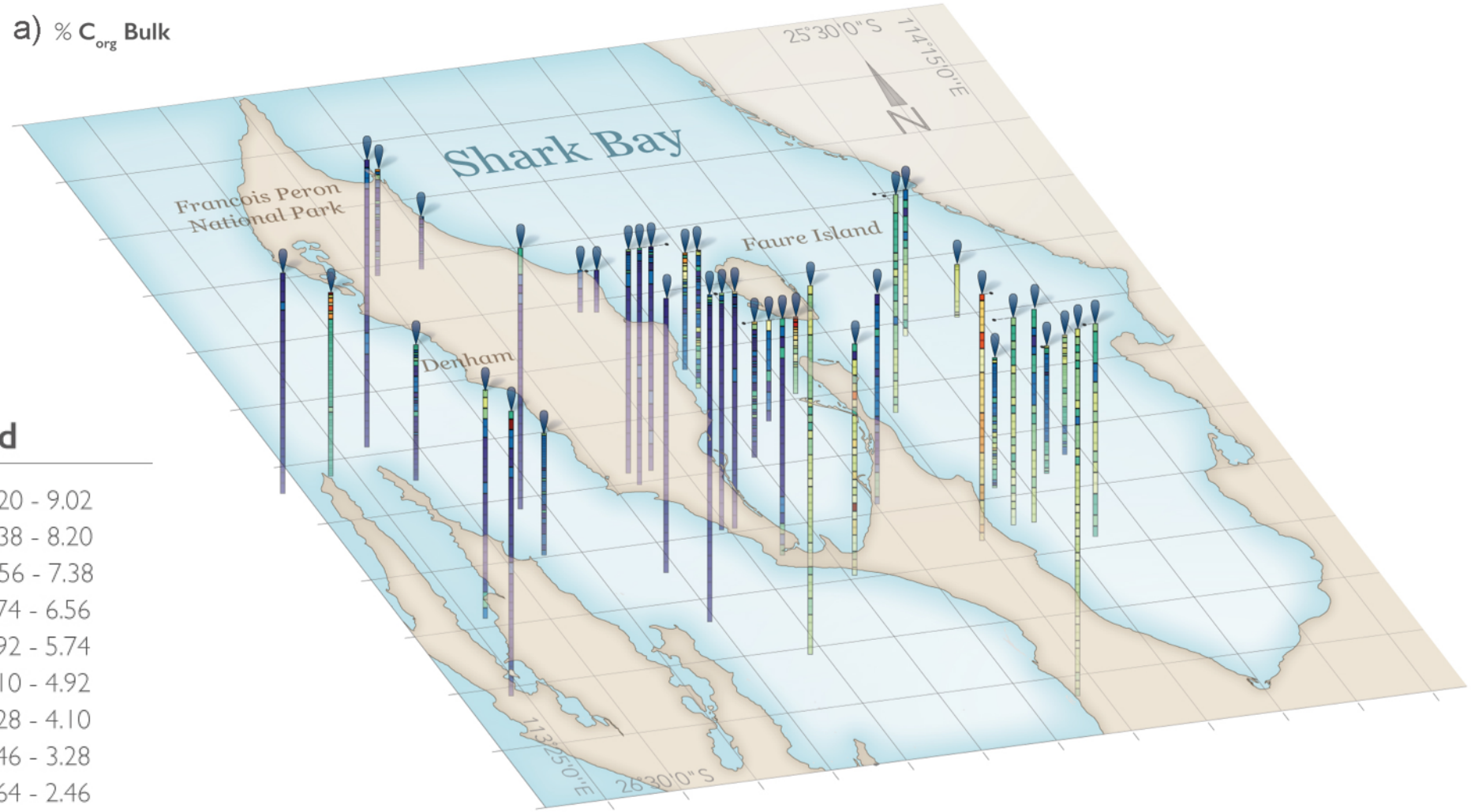
Overview Articles

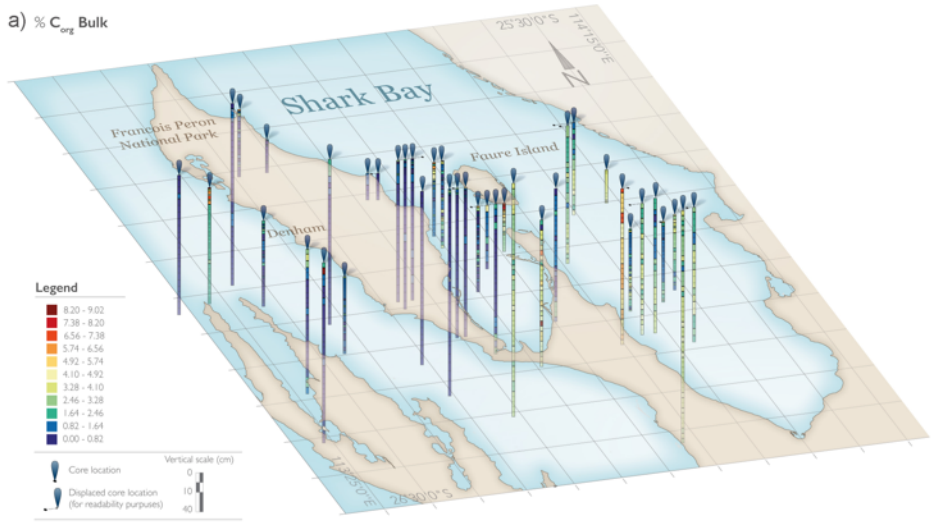
Accelerating Tropicalization and the Transformation of Temperate Seagrass Meadows

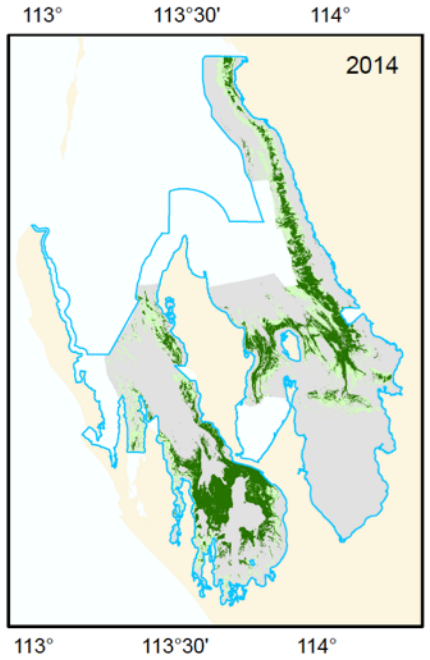
GLENN A. HYNDES, KENNETH L. HECK, Jr., ADRIANA VERGÉS, EUAN S. HARVEY, GARY A. KENDRICK, PAUL S. LAVERY, KATHRYN MCMAHON, ROBERT J. ORTH, ALAN PEARCE, MATHEW VANDERKLIFT, THOMAS WERNBERG, SCOTT WHITING, AND SHAUN WILSON

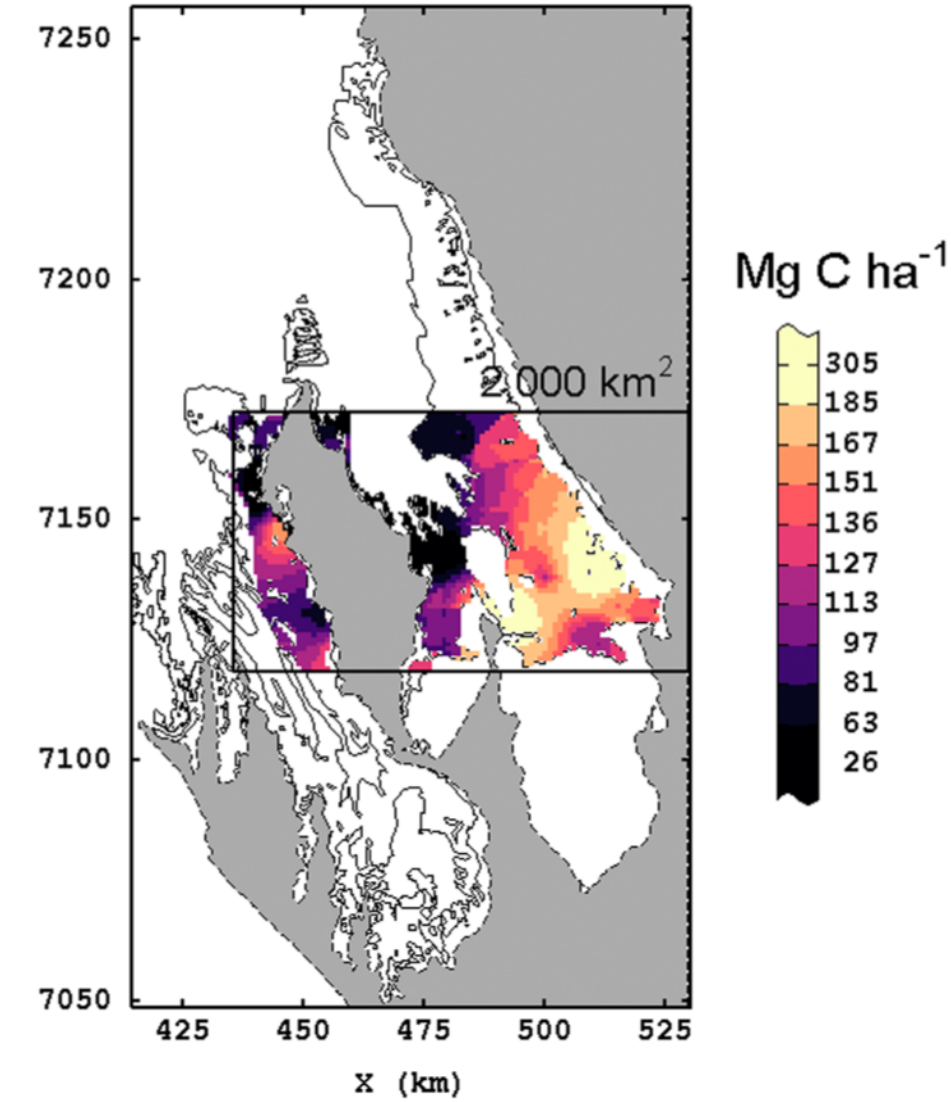
36% of Shark Bay's seagrass meadows damaged by 2010/2011 heatwave



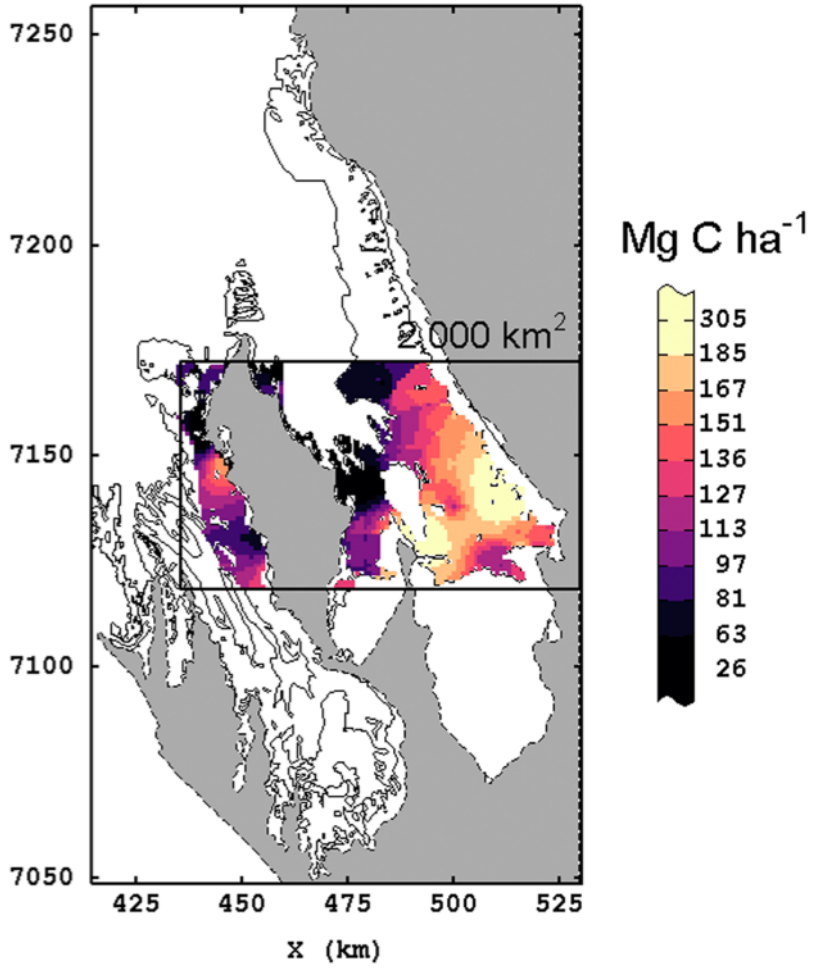

a) % C_{org} Bulk
Shark Bay
Francois Peron National Park
Faure Island
Denham
25°30'0"S
114°15'0"E
113°25'0"E
26°30'0"S
N
Legend
8.20 - 9.02
7.38 - 8.20
6.56 - 7.38
5.74 - 6.56
4.92 - 5.74
4.10 - 4.92
3.28 - 4.10
2.46 - 3.28
1.64 - 2.46
0.82 - 1.64
0.00 - 0.82


a) % C_{org} Bulk
Shark Bay
Francois Peron National Park
Faure Island
Denham
Legend
8.20 - 9.02
7.38 - 8.20
6.56 - 7.38
5.74 - 6.56
4.92 - 5.74
4.10 - 4.92
3.28 - 4.10
2.46 - 3.28
1.64 - 2.46
0.82 - 1.64
0.00 - 0.82
Vertical scale (cm)
Core location
Displaced core location (for readability purposes)


113°
113°30'
114°
2014
113°
113°30'
114°


a) Upper 1 meter C stocks
7250
7200
7150
7100
7050
425
450
475
500
525
X (km)
2,000 km^2
Mg C ha^{-1}
305
185
167
151
136
127
113
97
81
63
26

a) Upper 1 meter C stocks



Shark Bay has the largest C stock reported for a seagrass ecosystem globally

up to 1.3% of the total C stored within the top metre of seagrass sediments worldwide.

Relatively high sediment accumulation rate

1.6 – 4.5 mm y^{-1} = high carbon sequestration rates

Loss of seagrass therefore equates to:

High emissions of CO_2

Significant loss of C sequestration

Effects of seagrass area loss on seagrass area and organic carbon (C) stocks

Table 2 | Effects of the marine heatwave event on seagrass area and organic carbon (C) stocks under degraded seagrass meadows

	Marine Park area (8,900 km^2)	Extrapolated values for the entire bay (13,000 km^2)
Baseline seagrass area (km^2)	2,689	4,300
Dense	1,925	3,096
Sparse	765	1,204
C stock top metre (Tg C)	34 ± 14	55 ± 22
Seagrass area loss (km^2)	581	929
Shift to sparse seagrass (km^2)	118	190
Total damaged seagrass area (km^2)	699	1,125
3 yr net C loss from 1 m sediment stock (Tg C)		
α 0.10	0.30 ± 0.05	0.49 ± 0.08
α 0.25	0.76 ± 0.10	1.23 ± 0.15
α 0.50	1.52 ± 0.17	2.45 ± 0.27
3 yr net CO_2 emissions (Tg CO_2)	1.1–5.6	1.8–9.0

Potential Loss of 2 - 9 Mt of CO_2

2 - 9 Mt of CO_2

Increases Australia's emissions from land-use change by

4–21% p. a.

Equivalent to annual CO_2 output of:

800,000 homes
(i.e. all of Perth)

2 coal power stations

1,600,000 cars

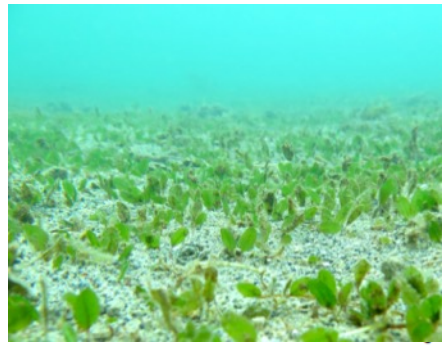
or all the cars in WA driven for 2 years

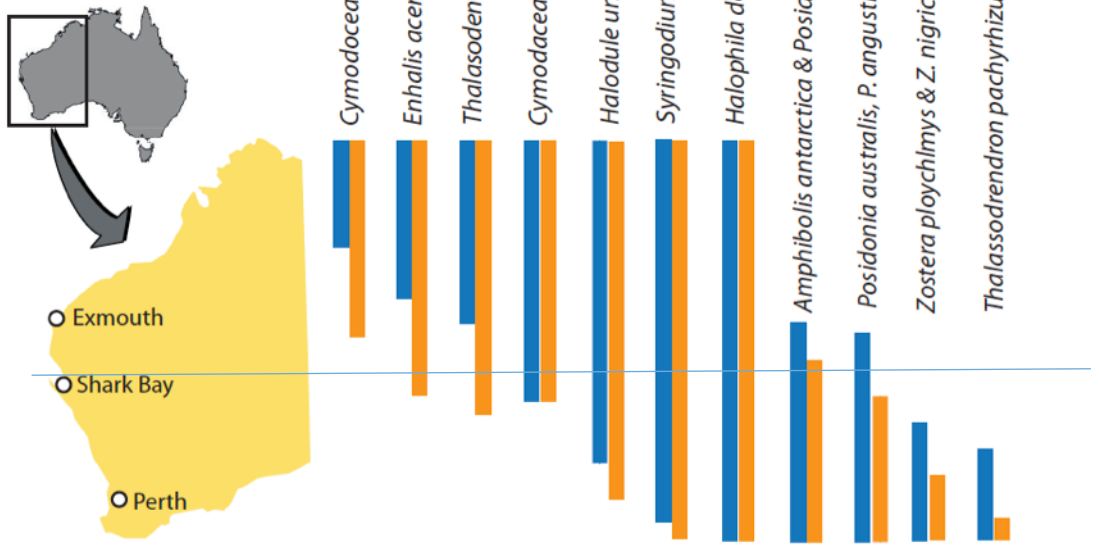
Overview Articles

Accelerating Tropicalization and the Transformation of Temperate Seagrass Meadows

GLENN A. HYNDES, KENNETH L. HECK, Jr., ADRIANA VERGÉS, EUAN S. HARVEY, GARY A. KENDRICK, PAUL S. LAVERY, KATHRYN MCMAHON, ROBERT J. ORTH, ALAN PEARCE, MATHEW VANDERKLIFT, THOMAS WERNBERG, SCOTT WHITING, AND SHAUN WILSON

- *More heatwave events predicted*
- *Food webs shift*
  from seagrass-detritus to direct-consumption
- *affecting ecosystem services, including:*
  - *nursery habitat role for fishery species,*
  - *carbon sequestration*
  - *trophic connectivity*





Implications for management

- *We tend to manage for local stressors*
  - *in SB, may be less important but still needs managing*
- *Global change likely more significant*
- *Manage for resilience- Resistance and Recovery*
  - *Re-populate with resistant genotypes?*
  - *Predict where HW will occur and pre-plant in resistant genotypes from currently warmer locations?*
  - *Understand where the source populations are for recovery*