Patterns and extent of intertidal mass mortalities following the 2021 Western North American Heatwave

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University of British Columbia

Climate trains the boxer, but weather throws the punches.*
Heatwaves (the punches) are expected to become more frequent and more severe. How will coastal marine ecosystems respond?

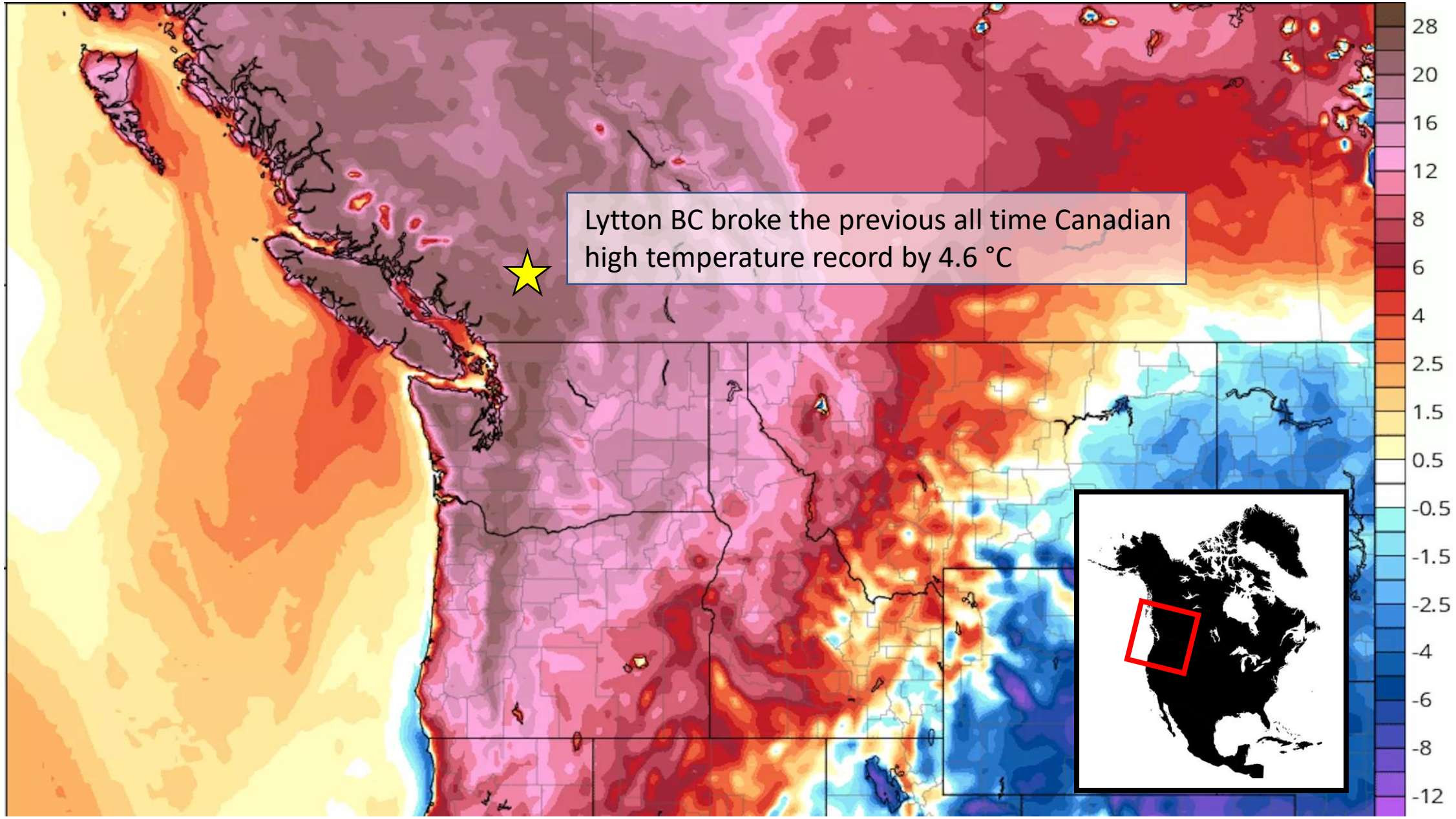
**paraphrasing Deke Arndt of NOAA*


Cassandra
Konecny

Seaside Array for Understanding Thermal Effects (SAUTE)

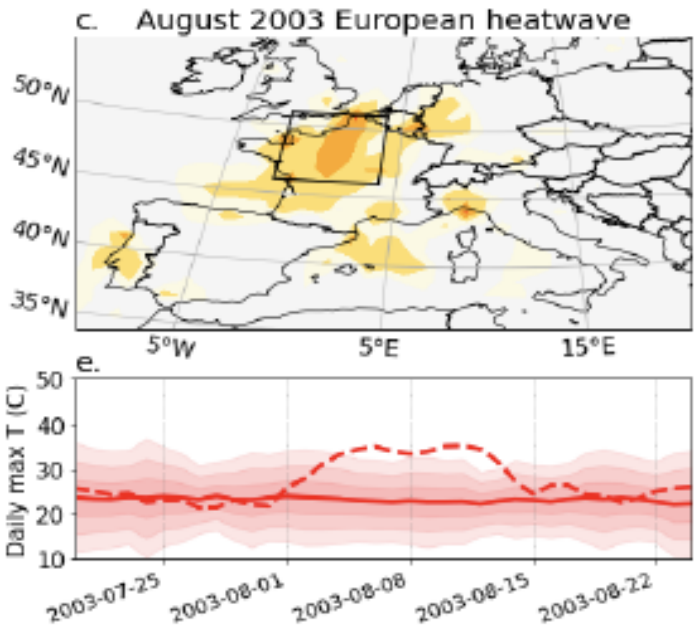
Konecny et al. 2021, Methods in Ecology and Evolution

Cassandra Konecny

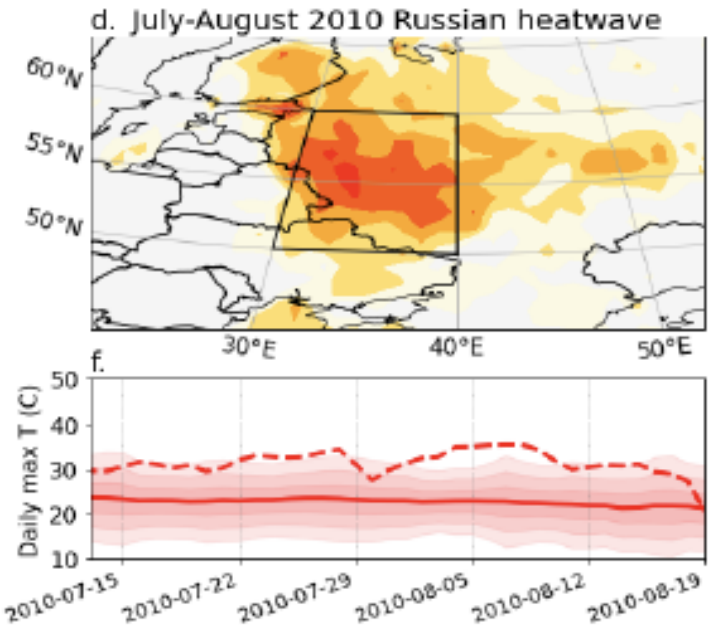


Computer model projection of temperature departures from average (degrees Celsius) on June 28. Image: Tropicaltidbits.com

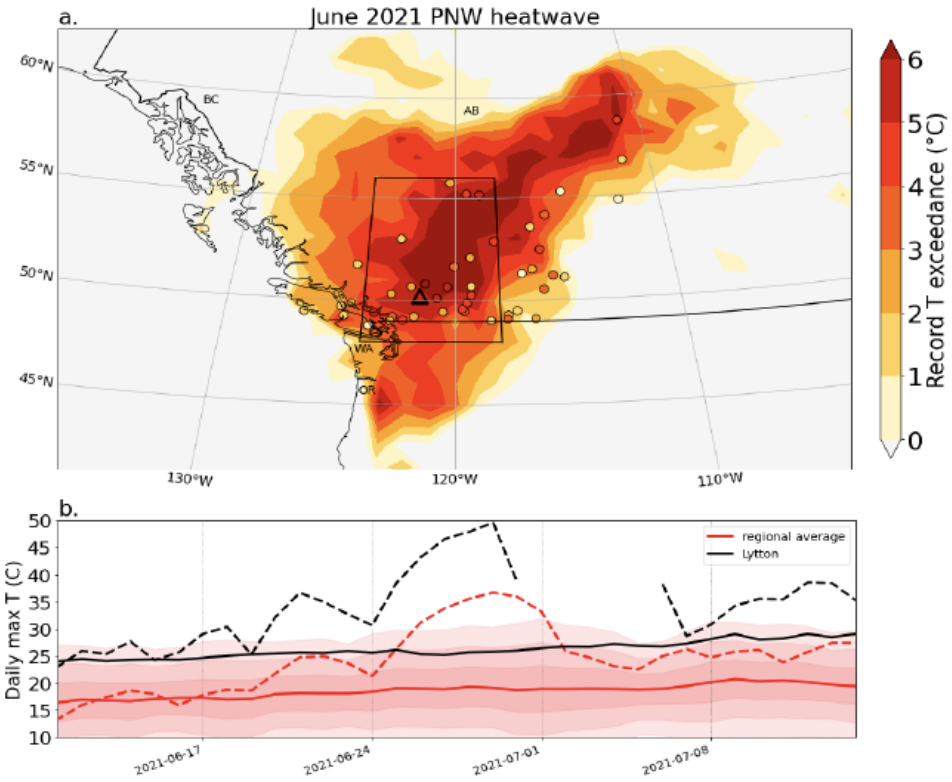
2003 European heatwave



2010 Russian heatwave



2021 western North American heatwave



Pink bands are 1, 2, 3 standard deviations away from the mean daily maximum air temperature from climatology (solid red line), dashed red lines are the measured daily maxima during the heatwave; black lines are specific to Lytton BC

White et al. in press, *Nature Communications*


How hot did it get on the shore?

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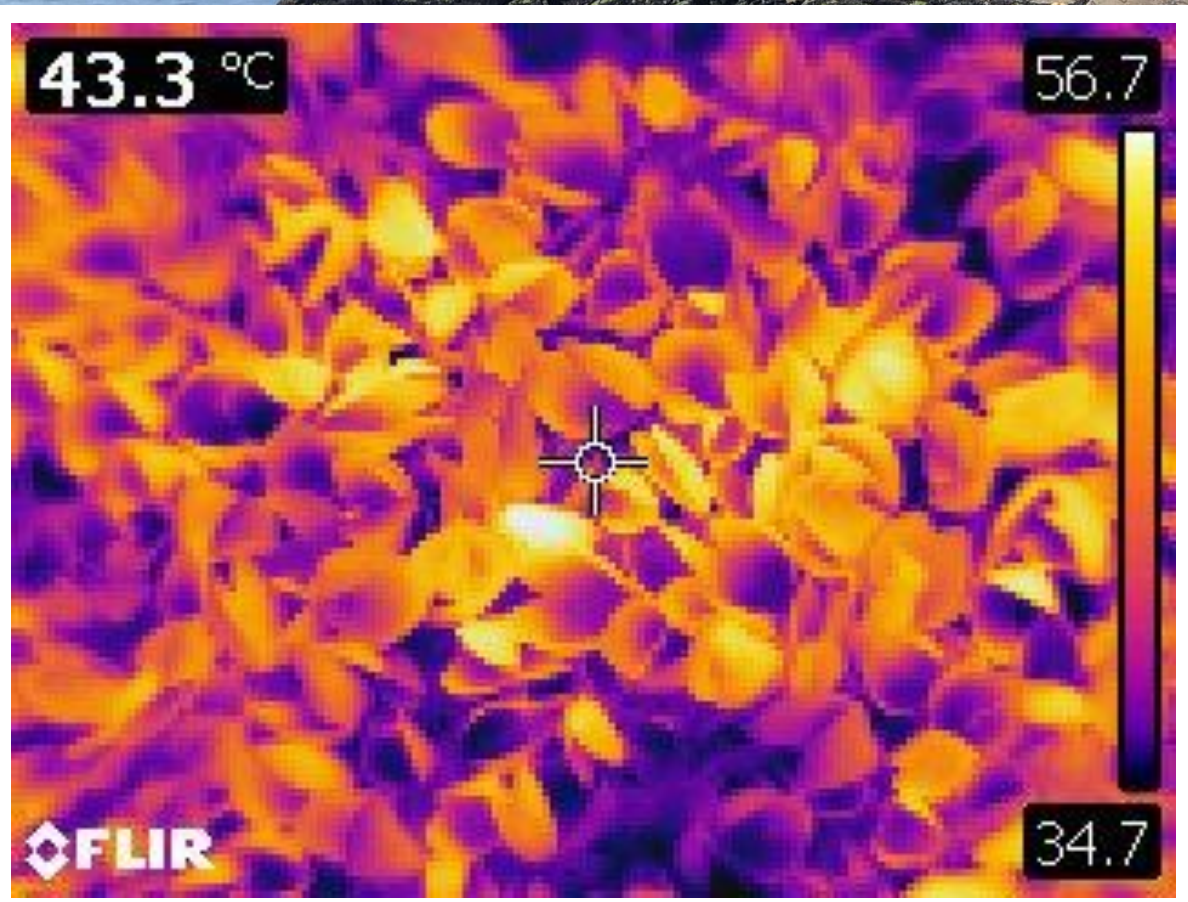
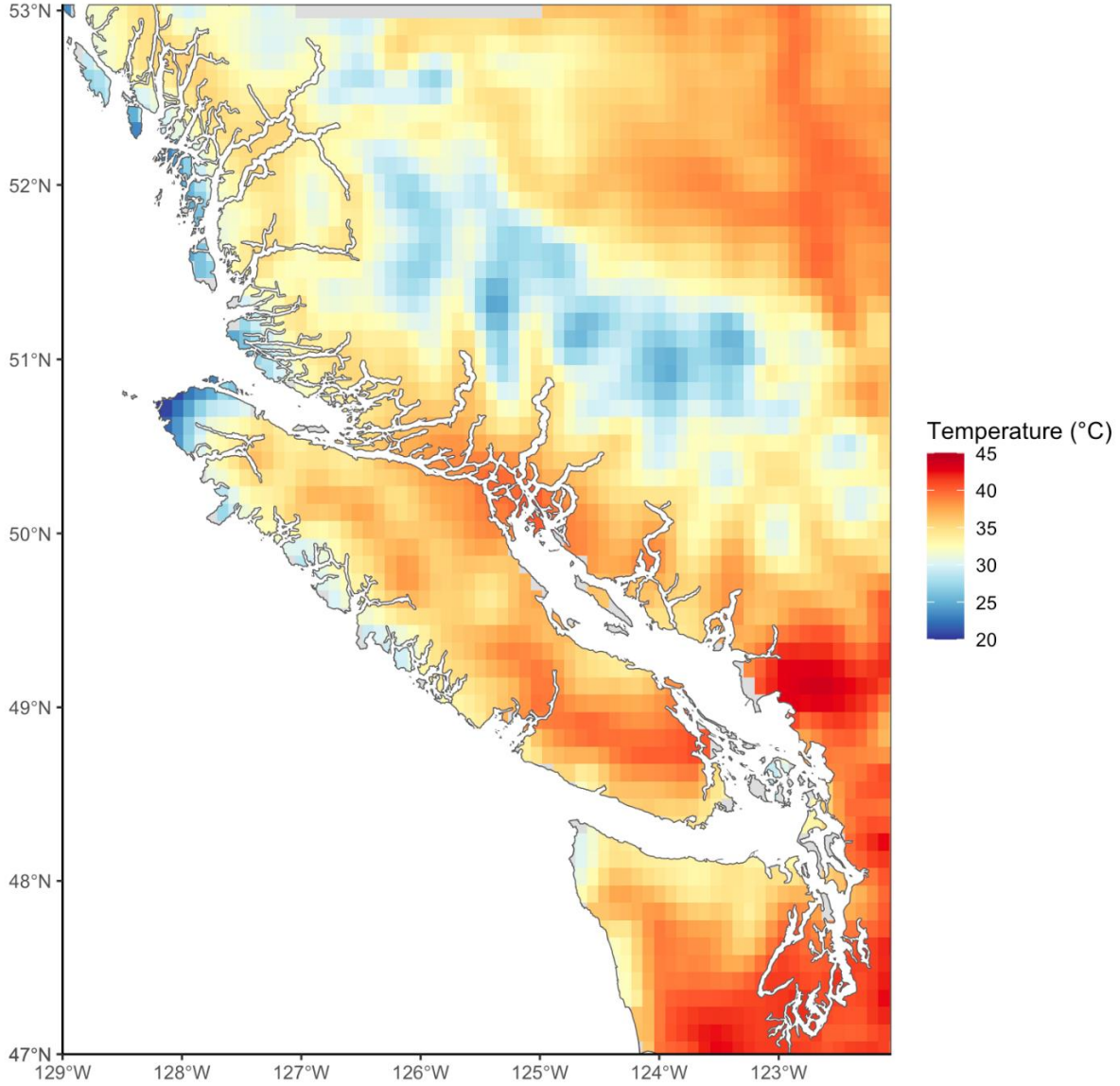


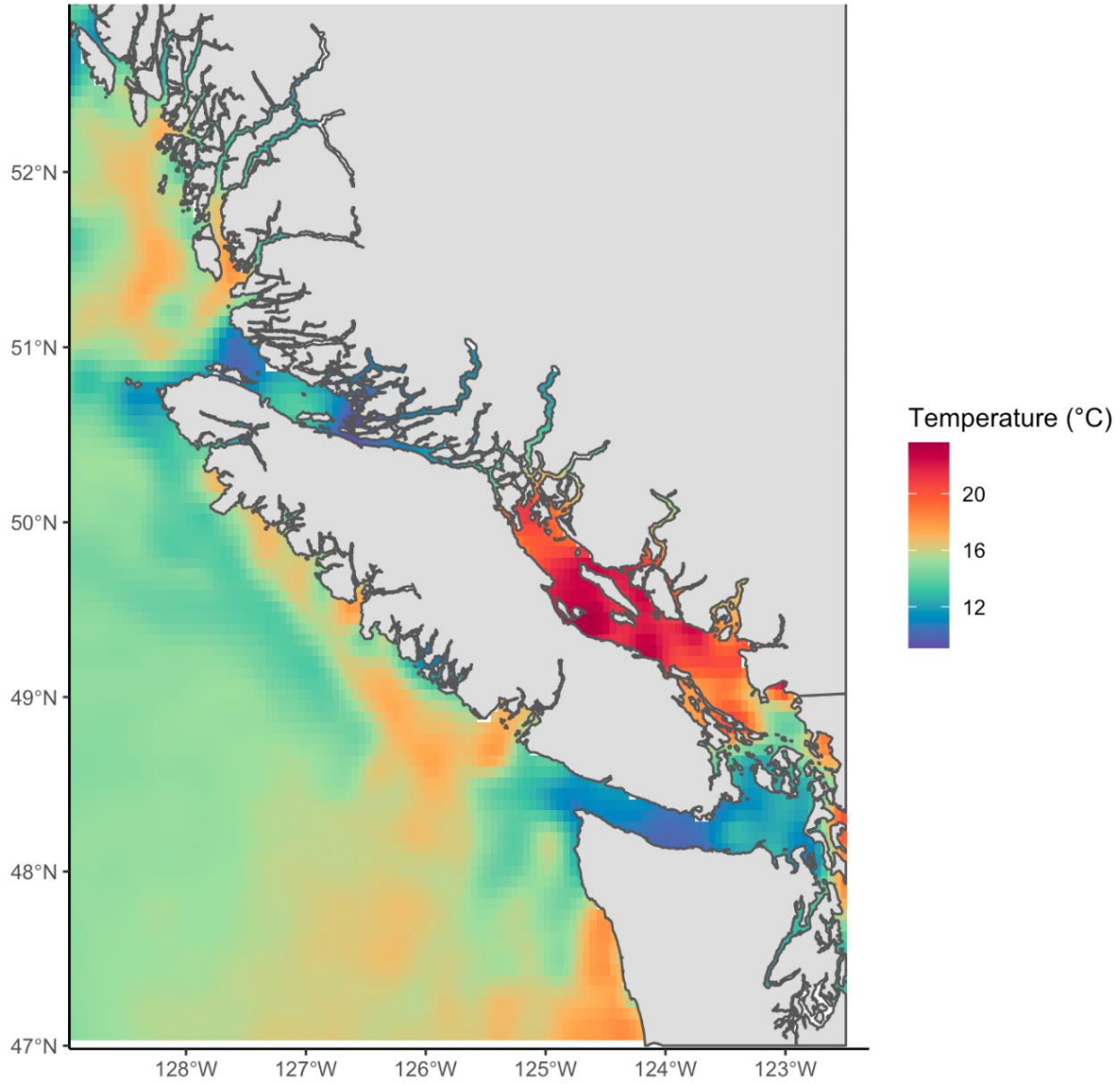
Dozens of species suffered at least some mortality

Many of the mobile animals found safe places to hide

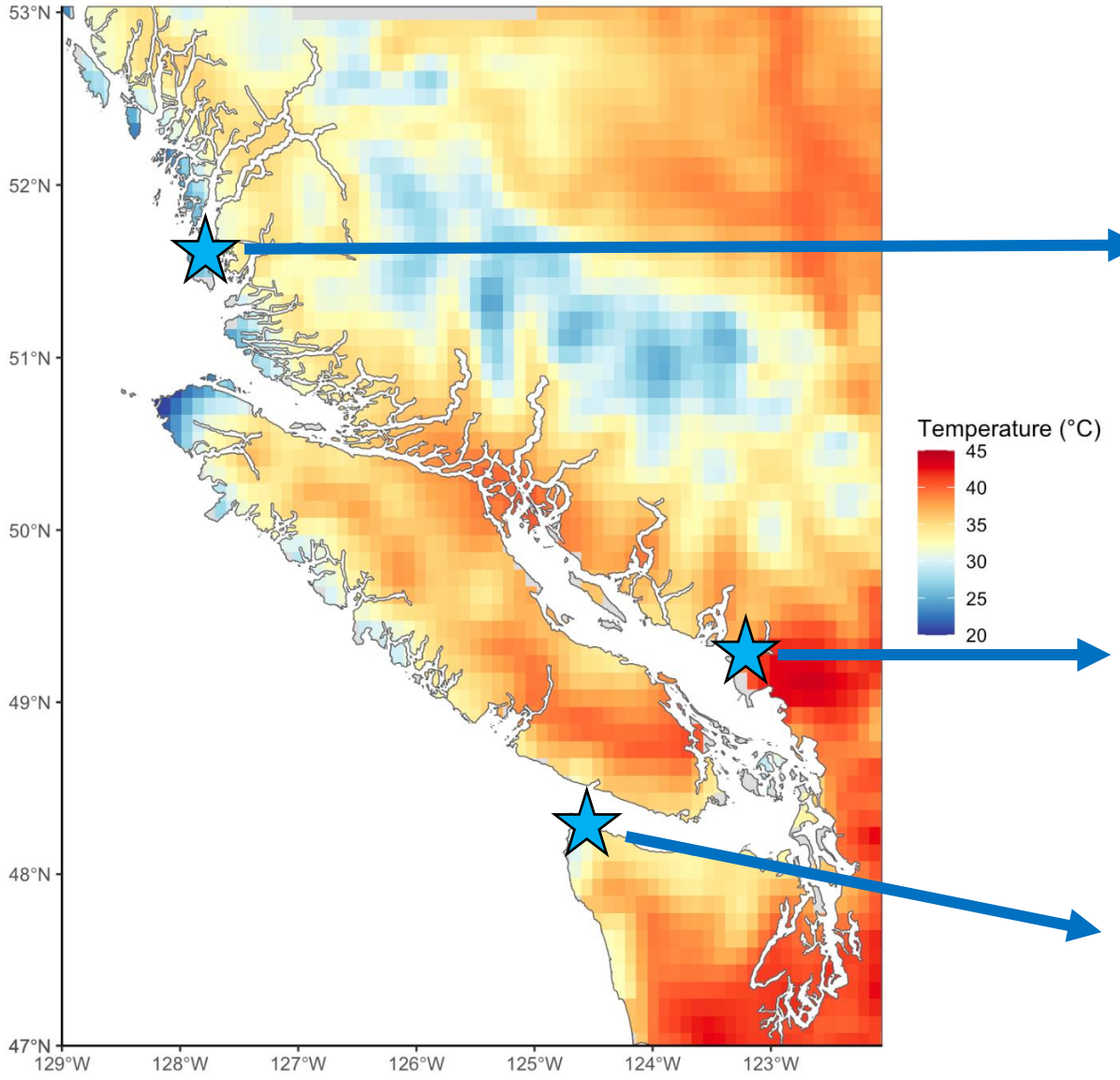
Sessile, habitat-forming species were hit especially hard



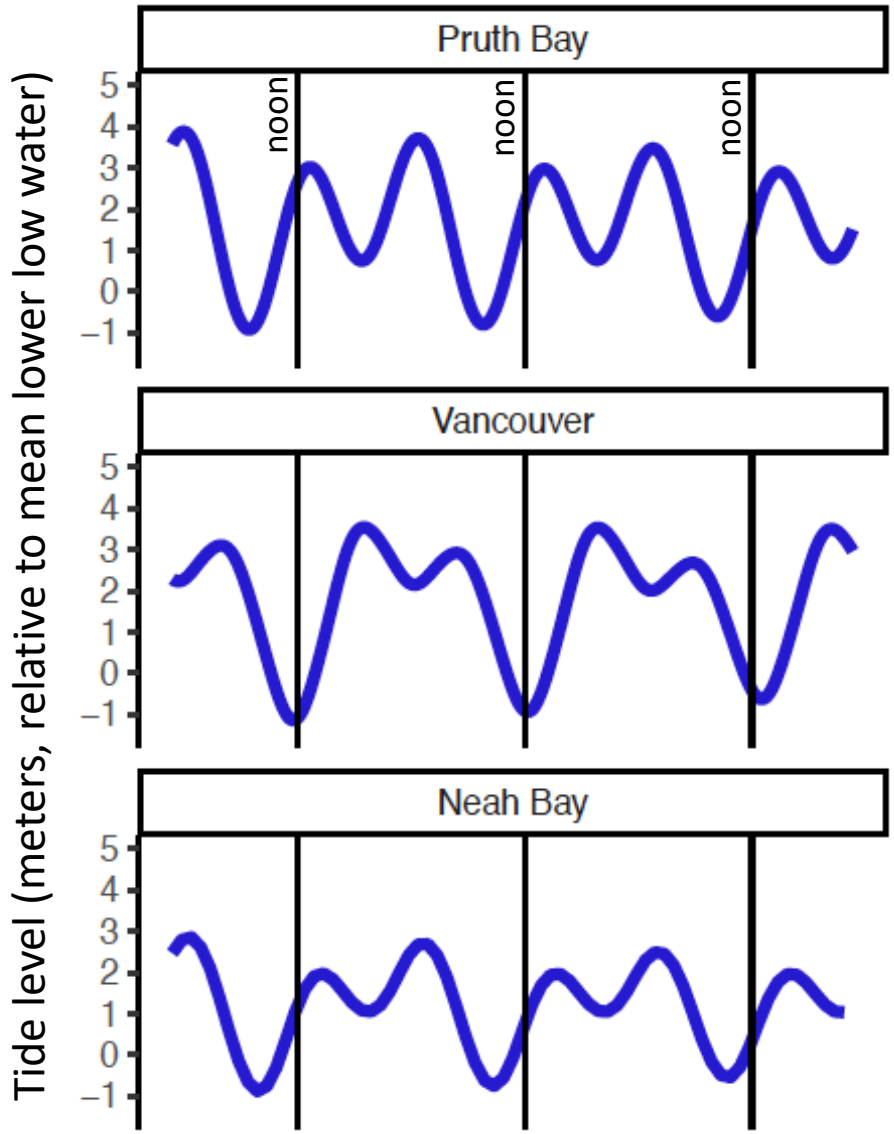
Maximum air temperature, 28 June 2021



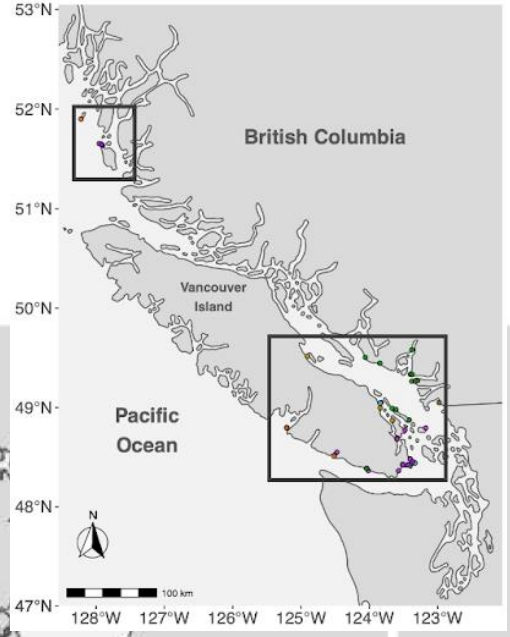
Sea surface temperature, 28 June 2021



Maximum air temperature, 28 June 2021



Tidal curves from the 2021 heatwave, from Raymond et al. 2021, *Ecology*



Calvert Island

20 km

Strait of Georgia

Vancouver Island

Strait of Juan de Fuca

60 km

Species

- *Balanus glandula*
- *Chthamalus dalli*
- *Magallana gigas*
- *Mytilus californianus*
- *Mytilus trossulus*
- *Nucella lamellosa*
- *Semibalanus cariosus*

Status

- Dead
- Alive

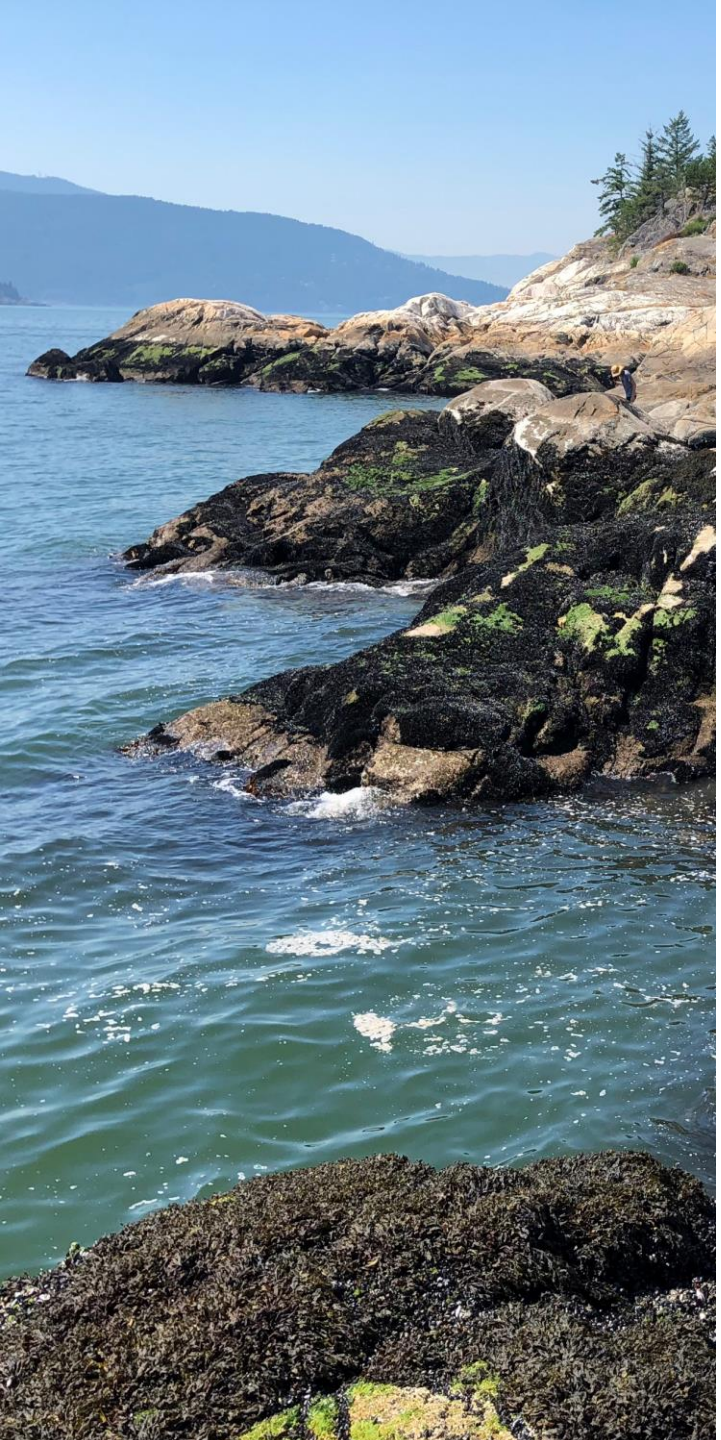
July 2020

north side

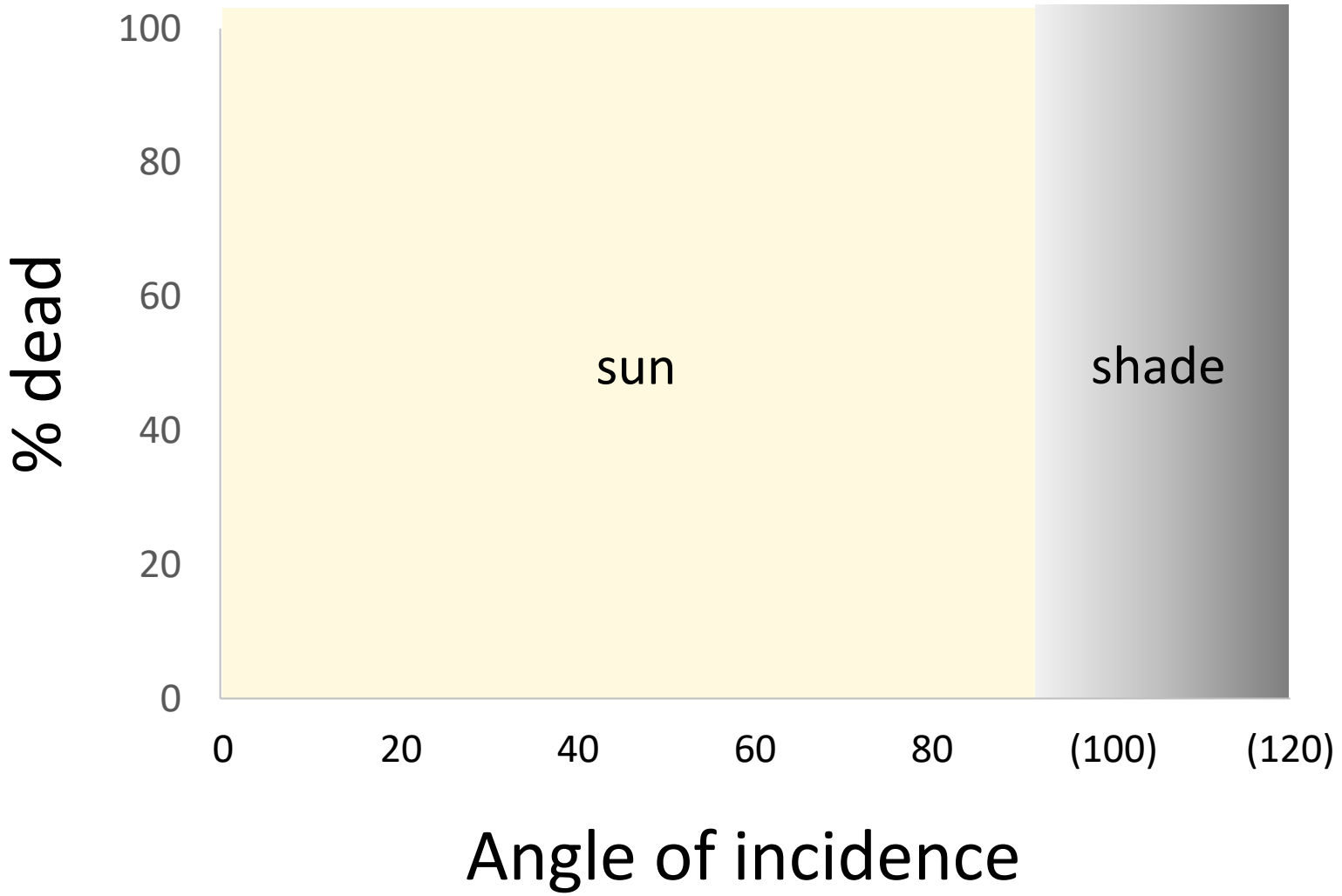
south side

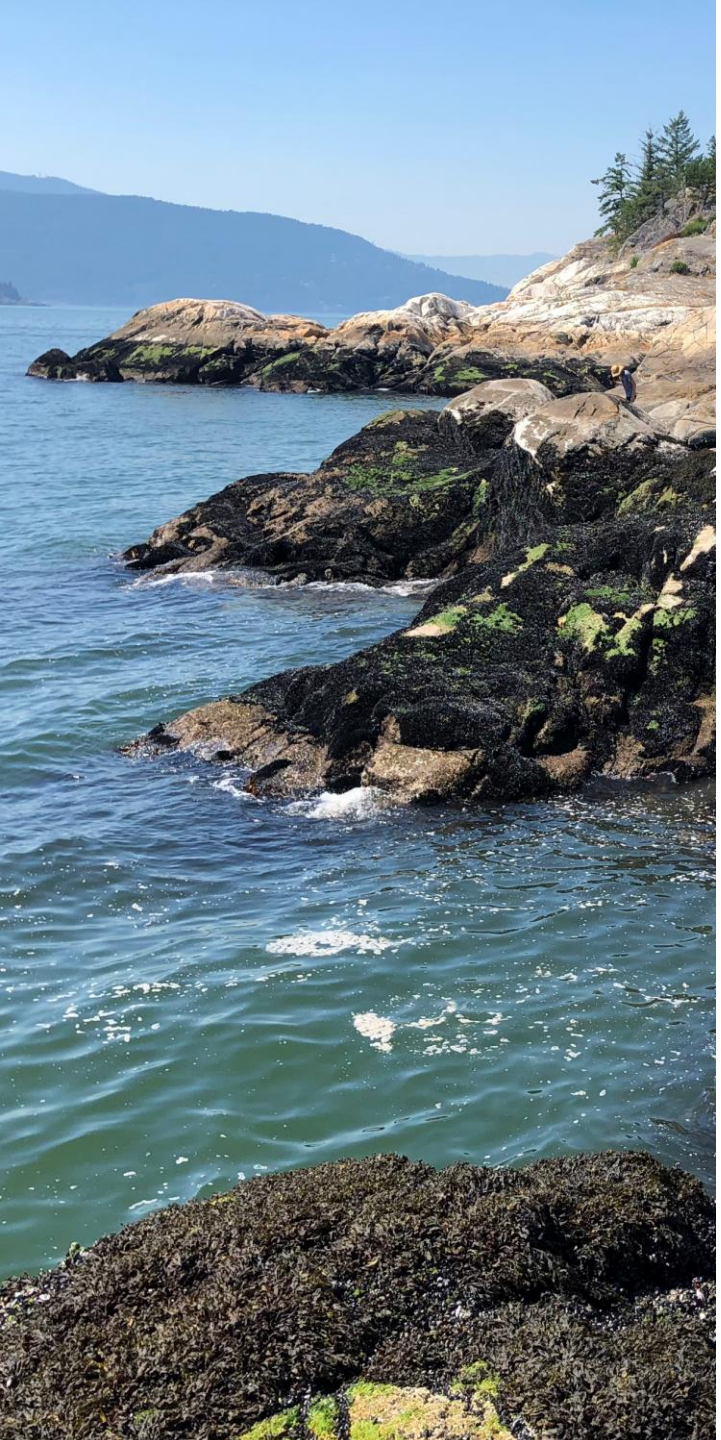
July 2020

July 2021



Patterns of mussel mortality





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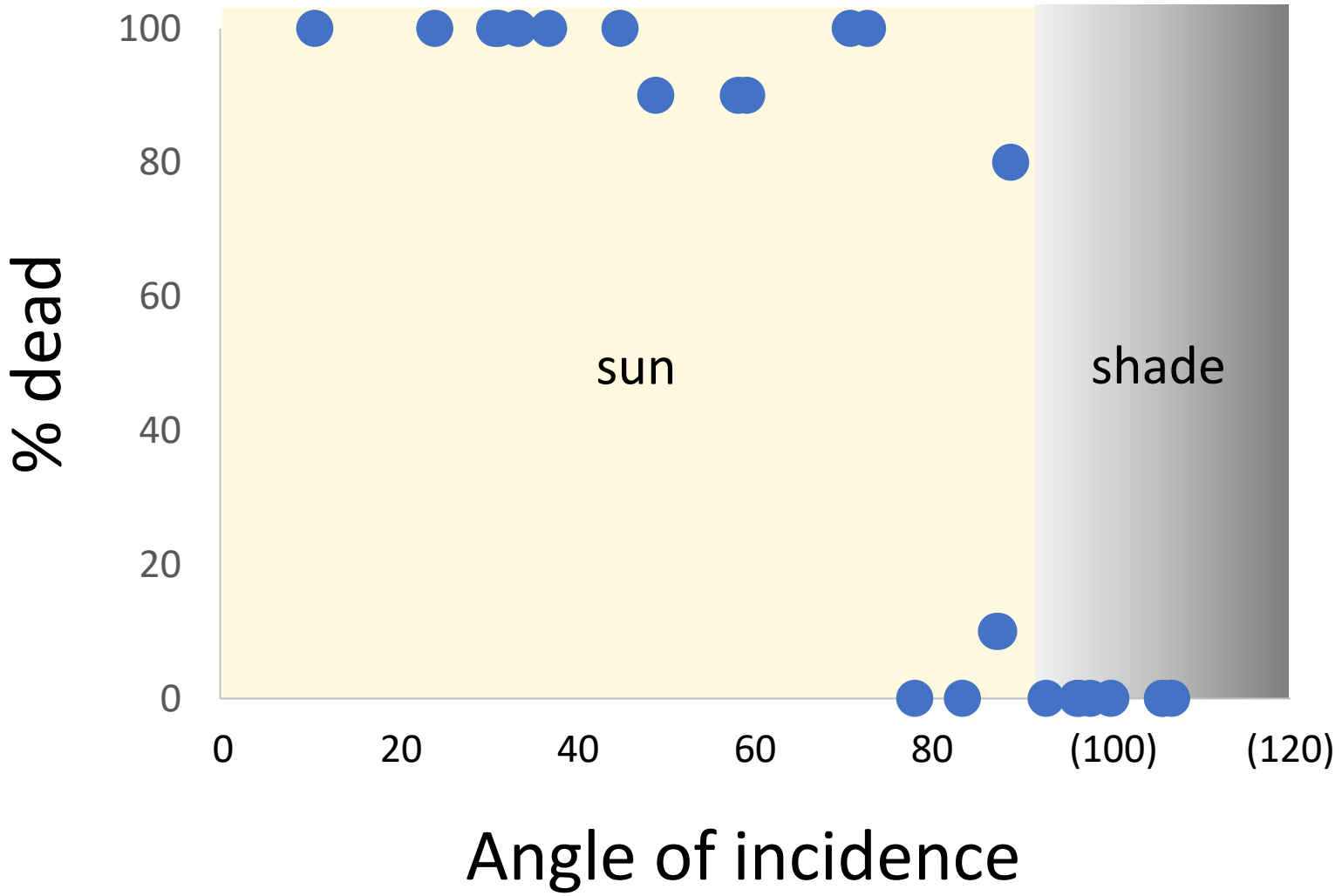
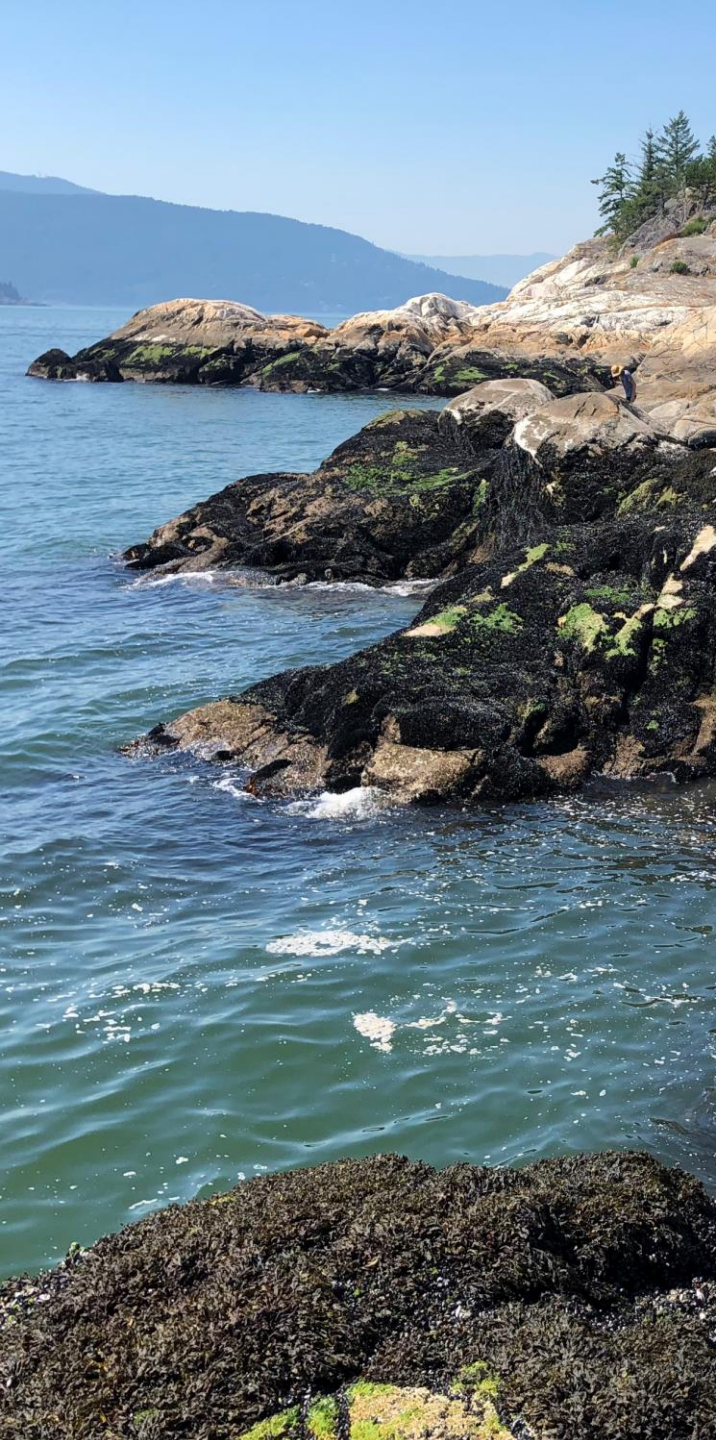
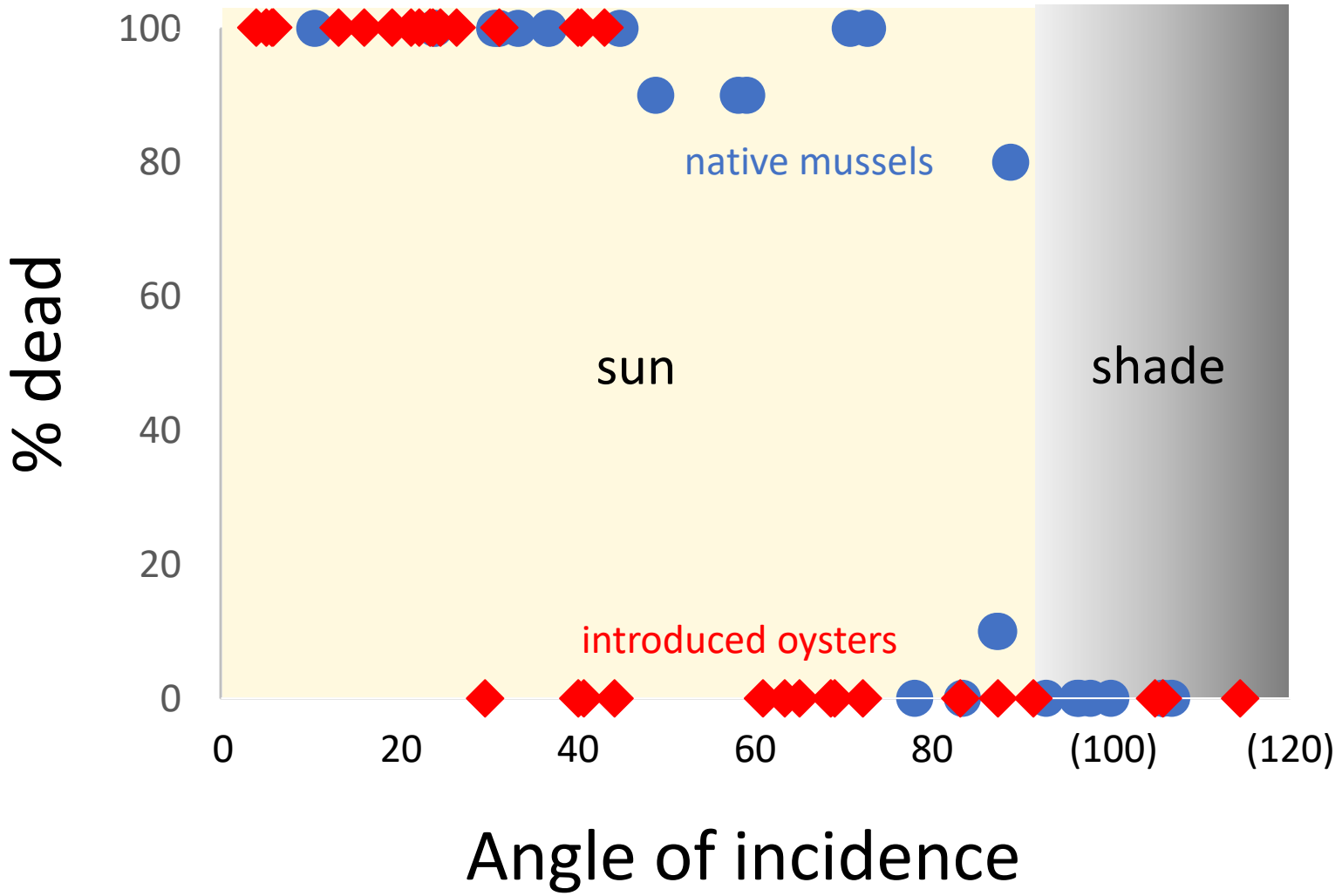
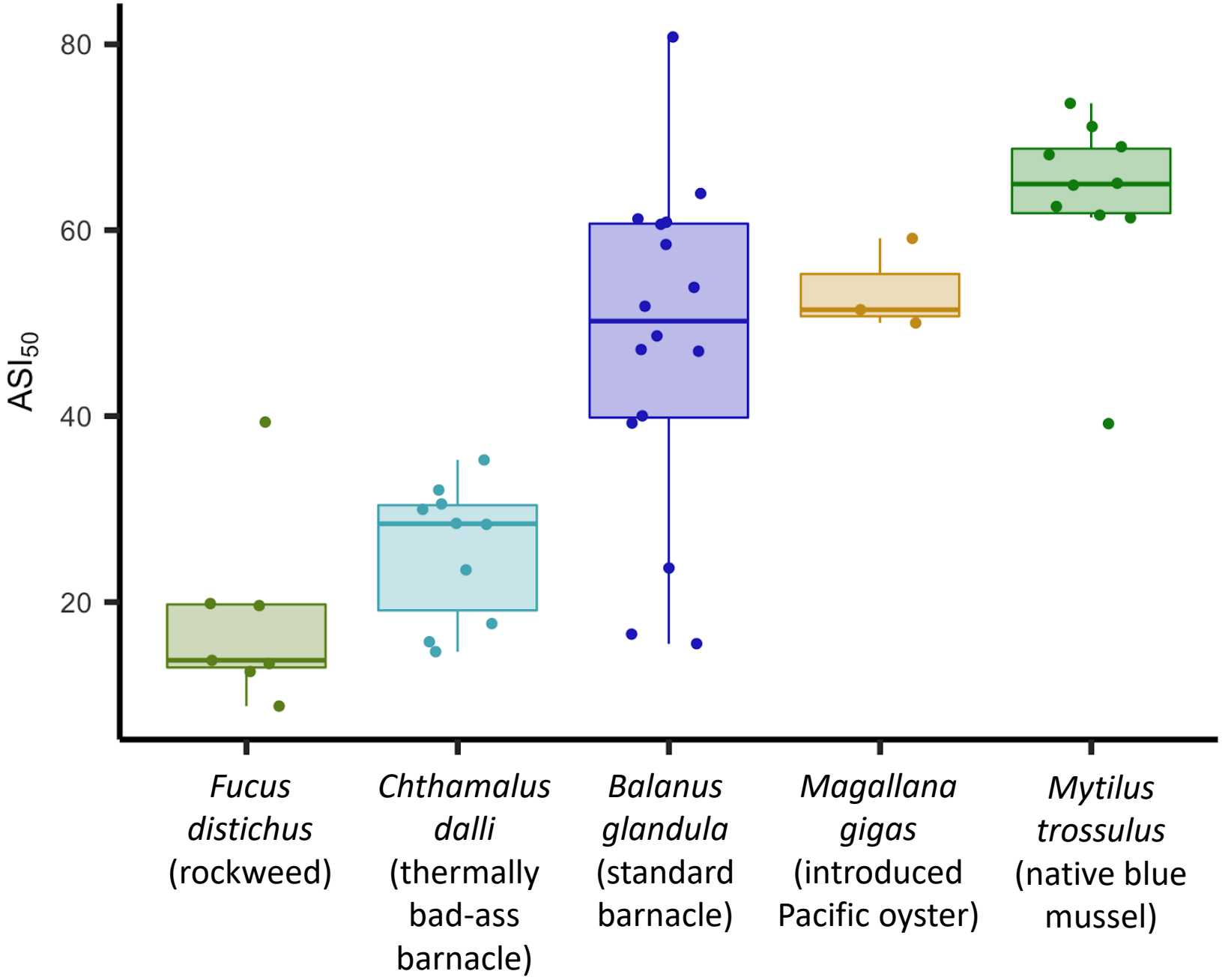




Patterns of bivalve mortality





4 June 2021

11 July 2021

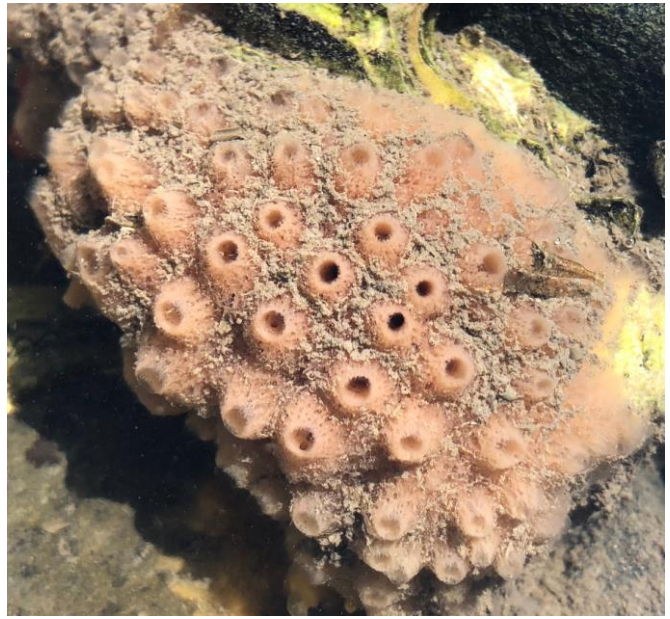
27 July 2021

photos courtesy of Lara Calvo

Many introduced species survived just fine and may be winners in the long term



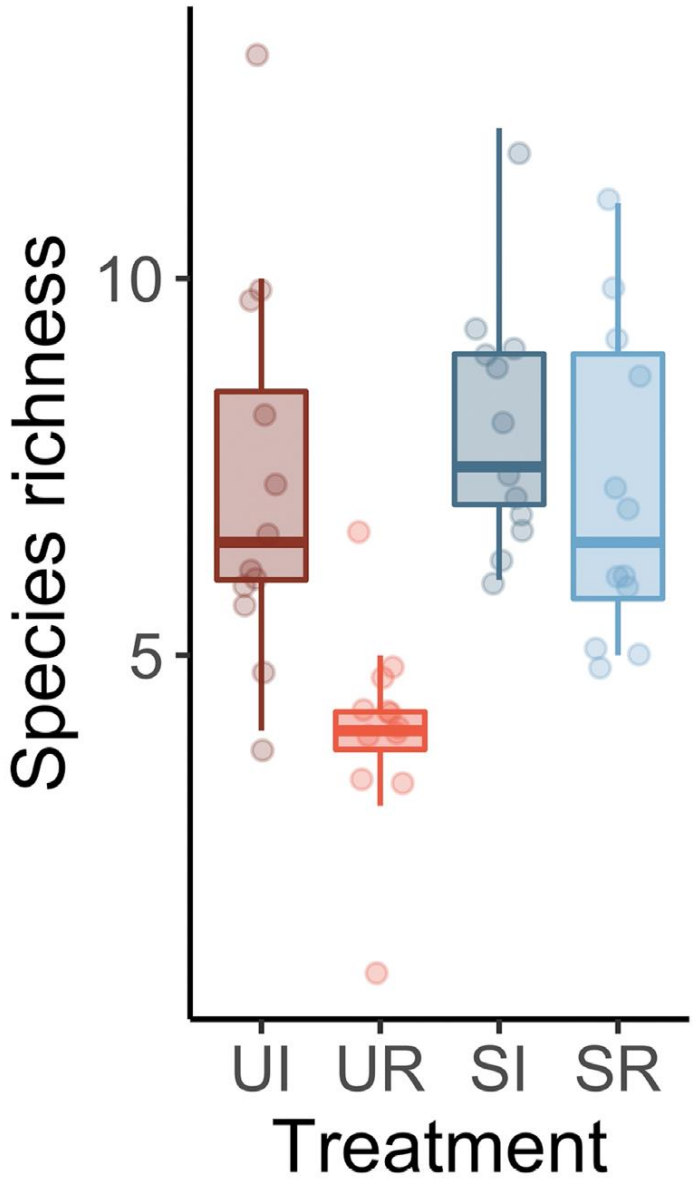


Is there anything we can do?

Amelia Hesketh

Ecosystems are better able to resist extreme temperatures when the major players are present. Local conservation matters!



U = unshaded
S = shaded
I = barnacles intact
R = barnacles removed

(from Hesketh & Harley 2022, GCB)

photo courtesy of Amelia Hesketh

What are the long-term prospects for the British Columbia coast?

- Fast growing species with good dispersal abilities (e.g., barnacles) are already well on their way to recovery
- Longer lived species (e.g., some clams) and those with poor dispersal (many seaweeds) will take longer
- Shores with high topographic complexity may provide important thermal refugia
- The presence of foundation species made a huge difference to survival for associated species
- With more frequent and more severe heatwaves, we can expect the ecosystem to shift to species from warmer parts of the world