

# Understanding marine ecosystem structure, function and stability from a network perspective

Tomás I. Marina

Georgina Cordone

Vanesa Salinas

Iara D. Rodríguez

Santiago R. Doyle

Fernando R. Momo

Leonardo A. Saravia

# This talk aims to be a review of:



Contents lists available at ScienceDirect

Estuarine, Coastal and Shelf Science

journal homepage: [www.elsevier.com/locate/ecss](http://www.elsevier.com/locate/ecss)



## The Food Web of Potter Cove (Antarctica): complexity, structure and function



Tomás I. Marina<sup>a, b, c, \*</sup>, Vanesa Salinas<sup>a, b</sup>, Georgina Cordone<sup>a, b</sup>, Gabriela Campana<sup>c, d</sup>, Eugenia Moreira<sup>d</sup>, Dolores Deregibus<sup>d</sup>, Luciana Torre<sup>e, f</sup>, Ricardo Sahade<sup>e, f</sup>, Marcos Tatián<sup>e, f</sup>, Esteban Barrera Oro<sup>a, h</sup>, Marleen De Troch<sup>g</sup>, Santiago Doyle<sup>b</sup>, María Liliana Quartino<sup>d</sup>, Leonardo A. Saravia<sup>b</sup>, Fernando R. Momo<sup>b, c</sup>

<sup>a</sup> Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Argentina

<sup>b</sup> Instituto de Ciencias Universidad Nacional de General Sarmiento, J.M. Gutierrez 1150, 1613, Los Polvorines, Argentina

<sup>c</sup> INEDES, Universidad Nacional de Luján, CC 221, 6700, Luján, Argentina

<sup>d</sup> Instituto Antártico Argentino, Cerrito 1248, C1010AAZ, Ciudad Autónoma de Buenos Aires, Argentina

<sup>e</sup> Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de Córdoba, Av. Vélez Sarsfield 299, 5000, Córdoba, Argentina

<sup>f</sup> Instituto de Diversidad y Ecología Animal (Consejo Nacional de Investigaciones Científicas y Técnicas), Argentina

<sup>g</sup> Marine Biology, Ghent University, Krijgslaan 281/S8, B-9000, Ghent, Belgium

<sup>h</sup> Museo Argentino de Ciencias Naturales B. Rivadavia, Av. A. Gallardo 470, C1405DJR, Buenos Aires, Argentina



## Effects of macroalgae loss in an Antarctic marine food web: applying extinction thresholds to food web studies

Georgina Cordone<sup>1</sup>, Tomás I. Marina<sup>2,3,4</sup>, Vanesa Salinas<sup>2</sup>, Santiago R. Doyle<sup>2,3</sup>, Leonardo A. Saravia<sup>2,3</sup> and Fernando R. Momo<sup>2,3</sup>

<sup>1</sup> Centro Nacional Patagónico (CCT CONICET-CENPAT), Centro Para el Estudio de Sistemas Marinos (CESIMAR), Puerto Madryn, Chubut, Argentina

<sup>2</sup> Universidad Nacional de General Sarmiento, Instituto de Ciencias (ICI), Los Polvorines, Buenos Aires, Argentina

<sup>3</sup> Universidad Nacional de Luján, Instituto de Ecología y Desarrollo Sustentable (INEDES), Luján, Buenos Aires, Argentina

<sup>4</sup> Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Centro Austral de Investigaciones Científicas (CADIC), Ushuaia, Tierra del Fuego, Argentina

- Salinas, V. A. (2020). Redes tróficas marinas: estructura, respuestas a las perturbaciones y estabilidad. (Doctoral thesis, Universidad Nacional de General Sarmiento, Argentina).

RESEARCH ARTICLE

## Architecture of marine food webs: To be or not be a 'small-world'

Tomás Ignacio Marina<sup>1,2,3,\*</sup>, Leonardo A. Saravia<sup>2,3</sup>, Georgina Cordone<sup>2,4</sup>, Vanesa Salinas<sup>2</sup>, Santiago R. Doyle<sup>2</sup>, Fernando R. Momo<sup>2,3</sup>

<sup>1</sup> Centro Austral de Investigaciones Científicas (CADIC-CONICET), Ushuaia, Argentina, <sup>2</sup> Instituto de Ciencias, Universidad Nacional de General Sarmiento, Los Polvorines, Argentina, <sup>3</sup> INEDES, Universidad Nacional de Luján, Luján, Argentina, <sup>4</sup> Centro Para el Estudio de Sistemas Marinos (CESIMAR), Centro Nacional Patagónico (CENPAT), Puerto Madryn, Argentina

\* These authors contributed equally to this work.

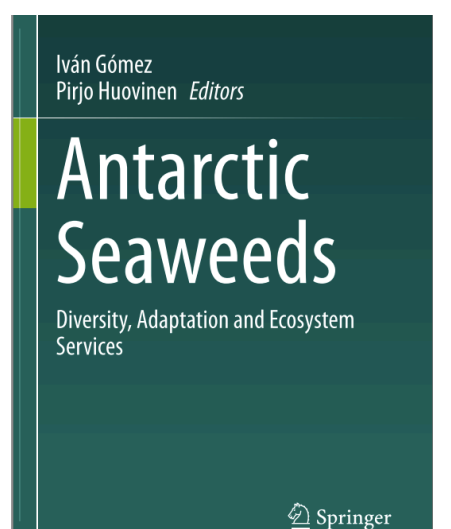
‡ These authors also contributed equally to this work.

\* [tomasimarina@gmail.com](mailto:tomasimarina@gmail.com)

## Chapter 15 Seaweeds in the Antarctic Marine Coastal Food Web



Fernando R. Momo, Georgina Cordone, Tomás I. Marina, Vanesa Salinas, Gabriela L. Campana, Mariano A. Valli, Santiago R. Doyle, and Leonardo A. Saravia

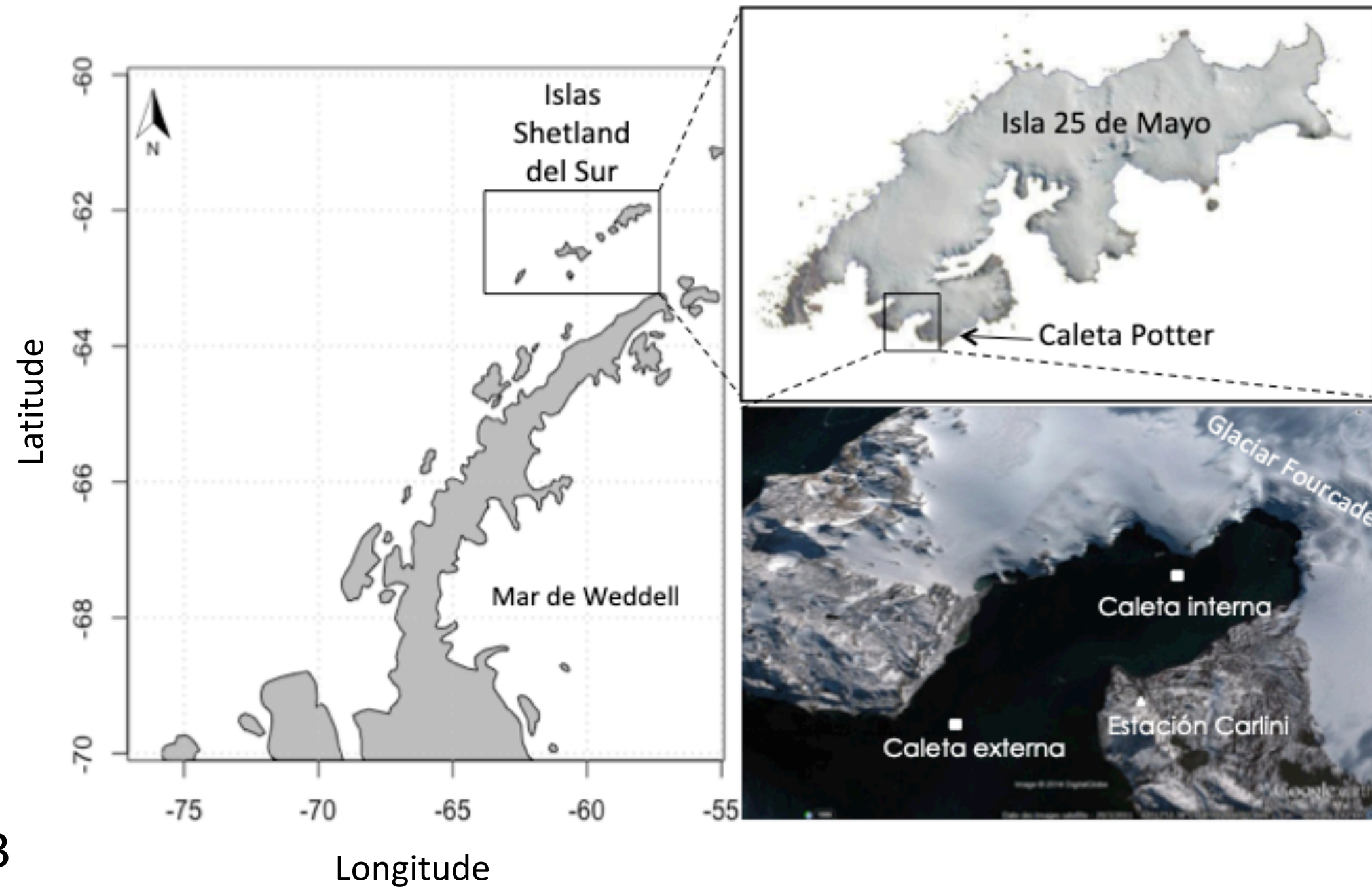
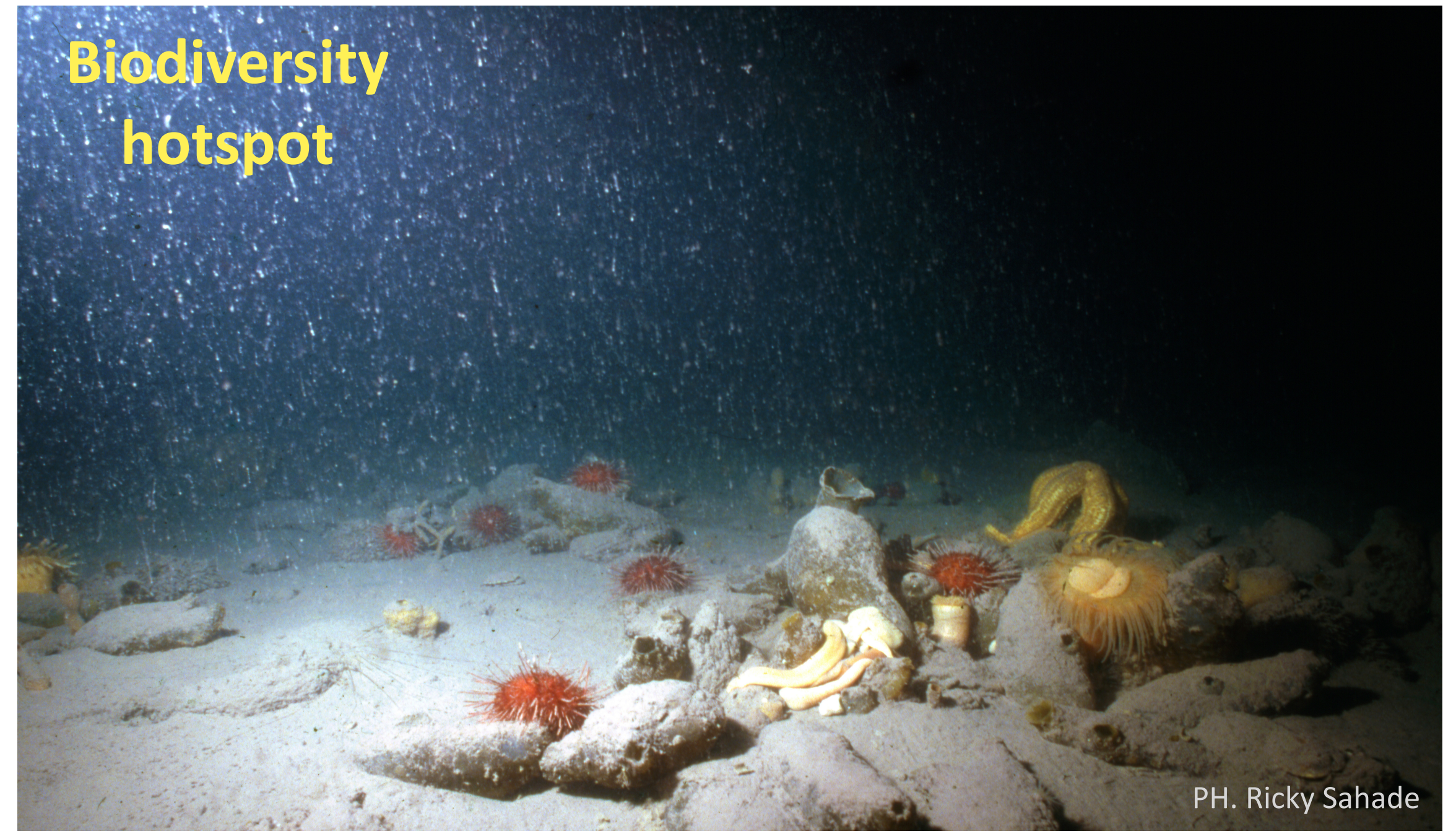


- Does space really matter? Effects of spatial heterogeneity on multidimensional stability in a highly resolved empirical food web. Cordone, G., Salinas, V., Marina, T. I., Doyle, S. R., Pasotti, F., Saravia, L. A., Momo, F. R. Food Webs in revision.

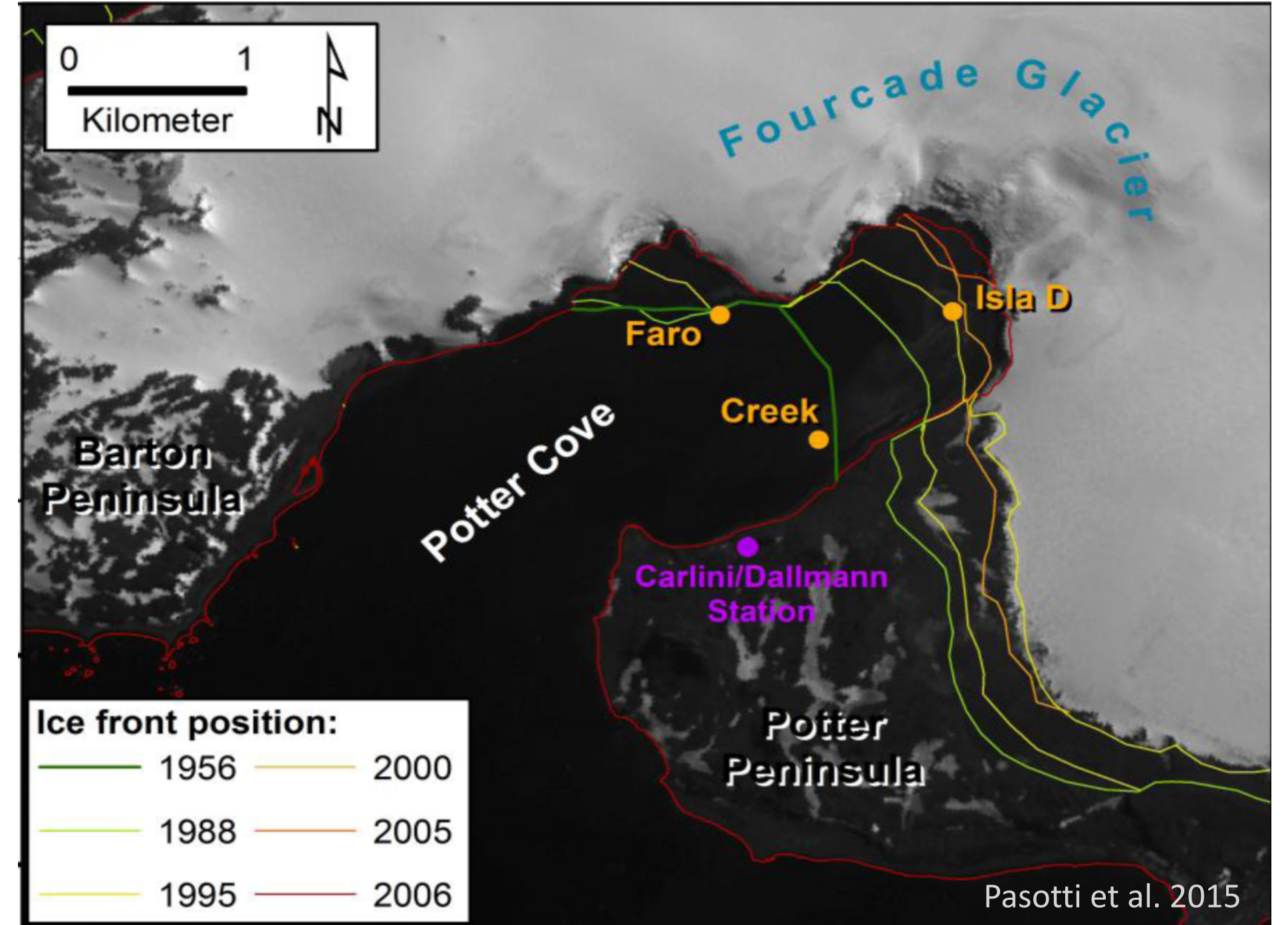
# Potter Cove

25 de Mayo / King George Is.

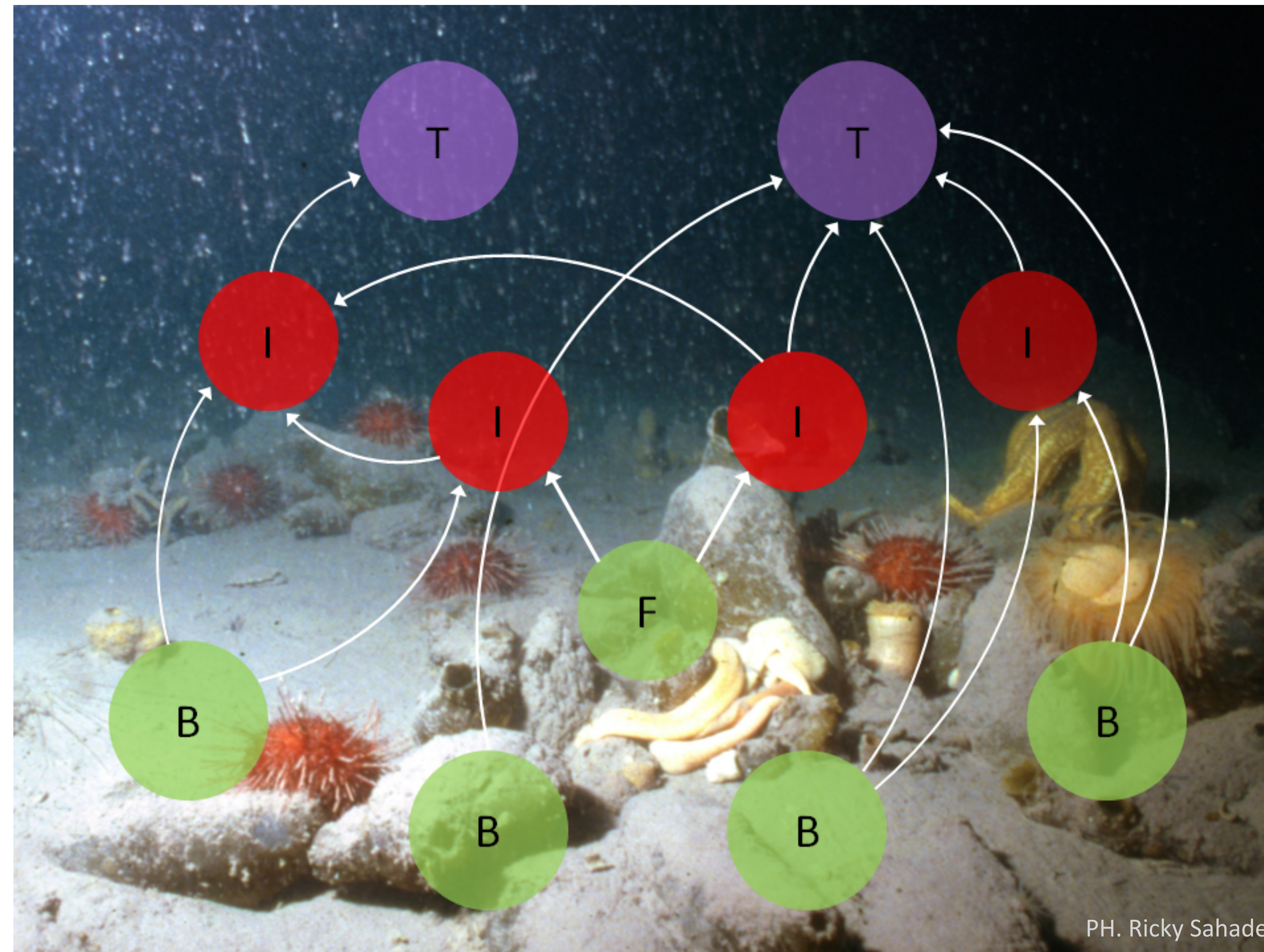
Antarctic Peninsula



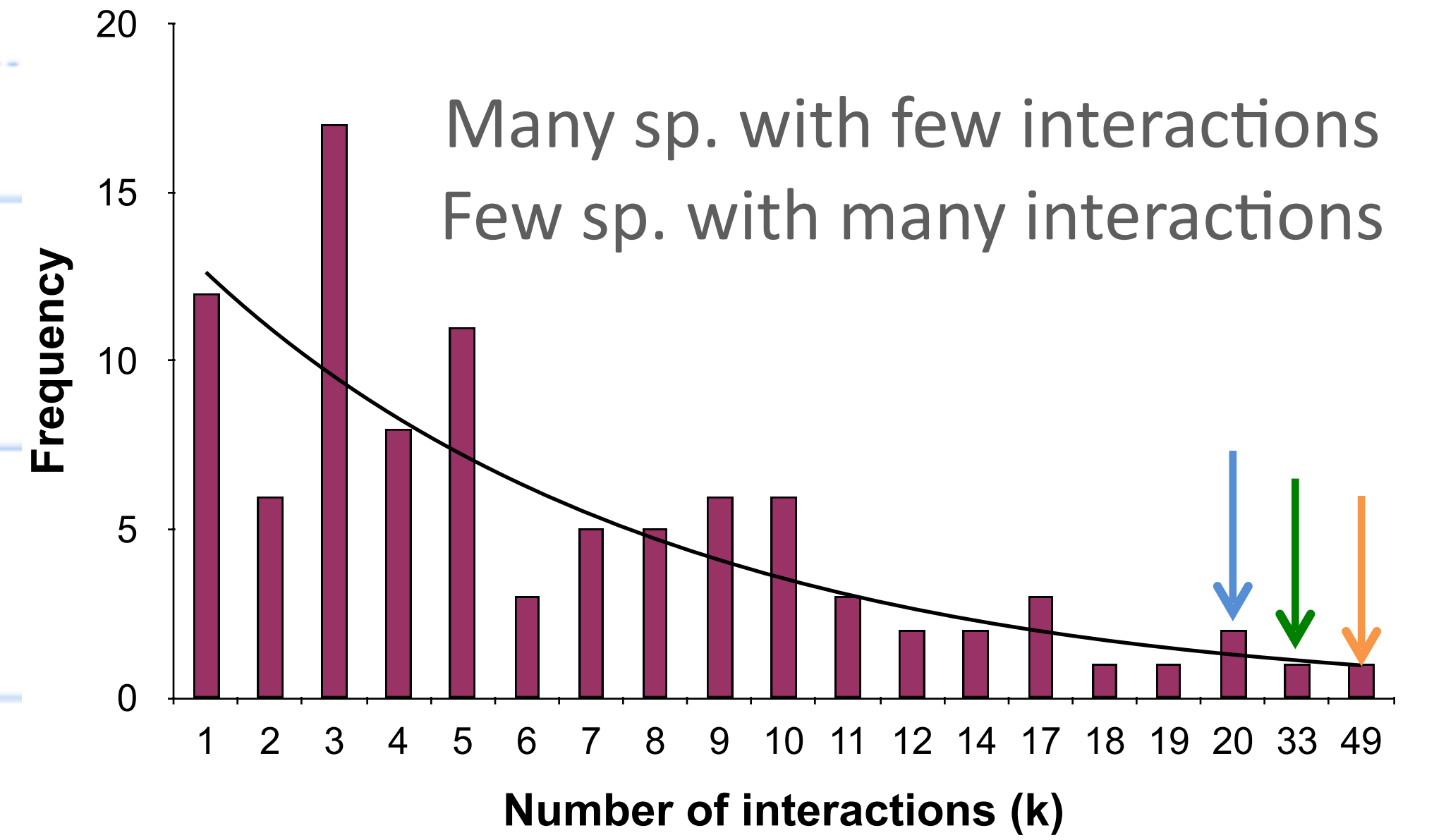
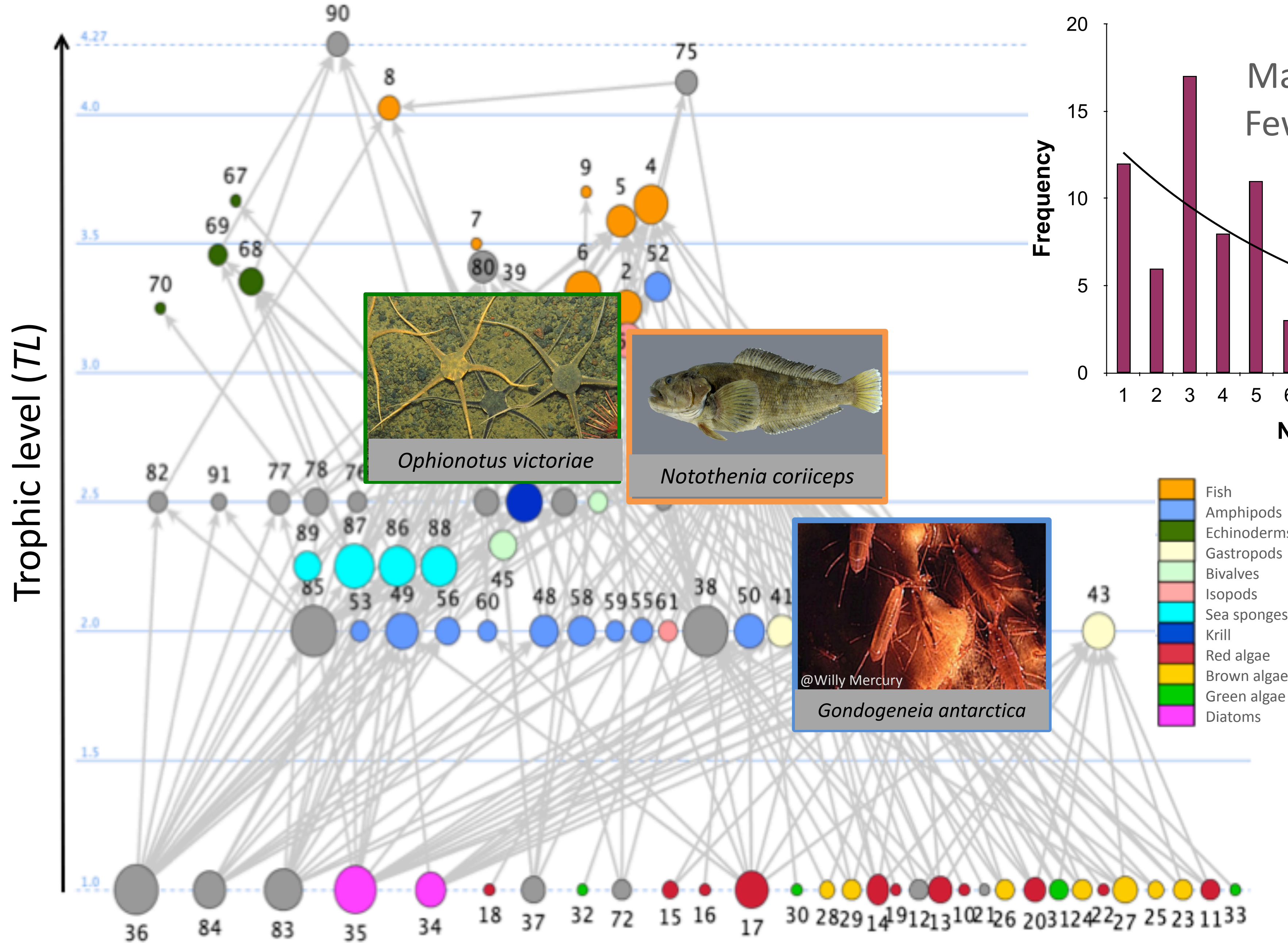
Glacier retreat



# 5 findings of Potter Cove ecosystem by applying a network approach



# Finding 1: Potter Cove ecosystem holds a complex food web

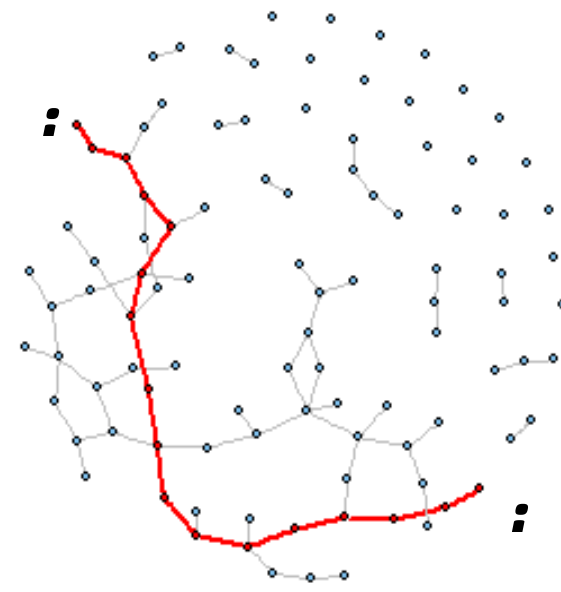


Complexity and structure	
# species $S$	91
# interactions $L$	309
Connectance ( $L/S^2$ )	0.04
Basal sp. (%)	19
Intermediate sp. (%)	47
Top sp. (%)	34
Mean $TL$	2.14
Omnivory (%)	45
Clustering	0.09
Distance btw sp.	1.82

# Finding 2: Potter Cove food web is not a small-world network

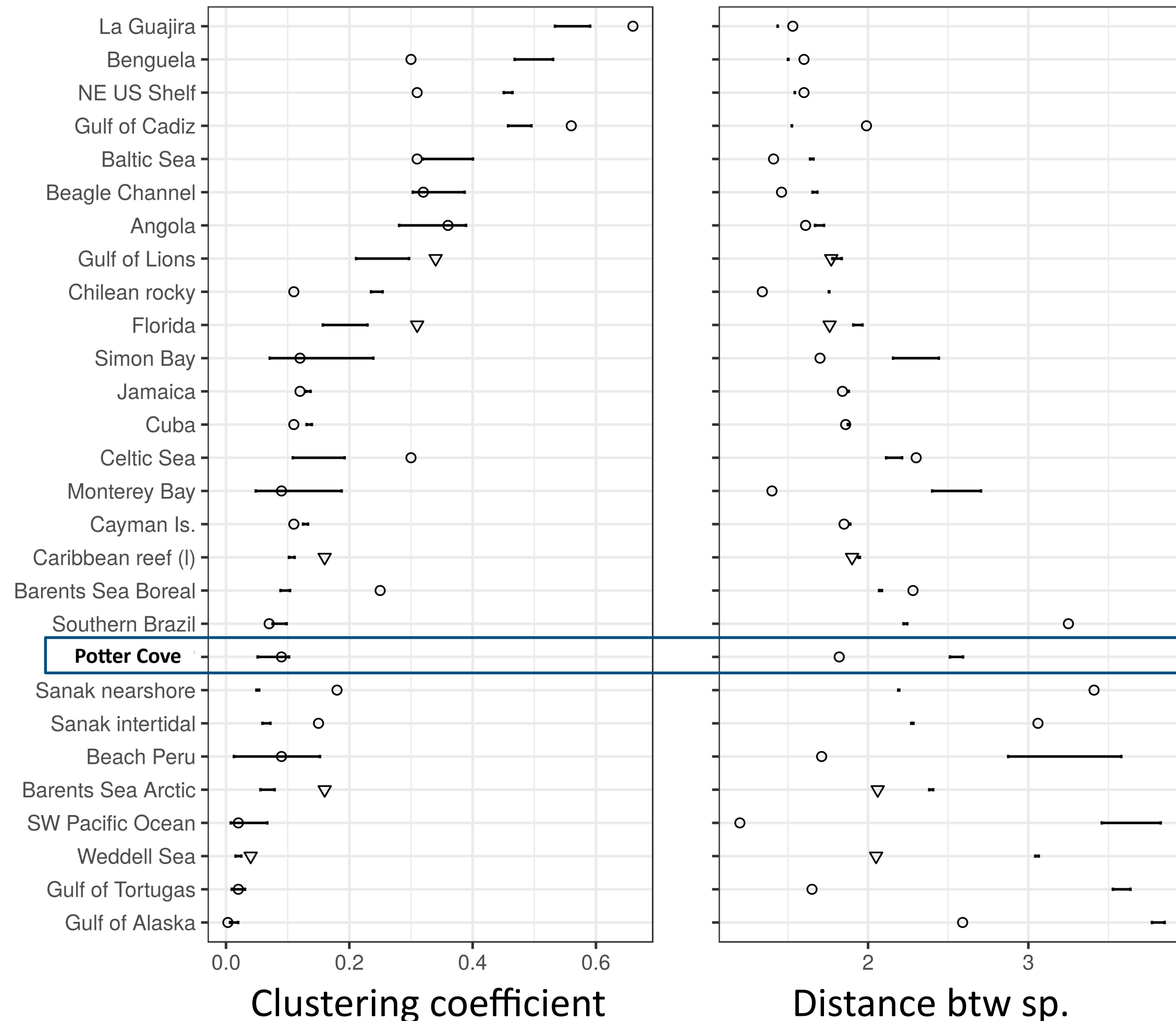
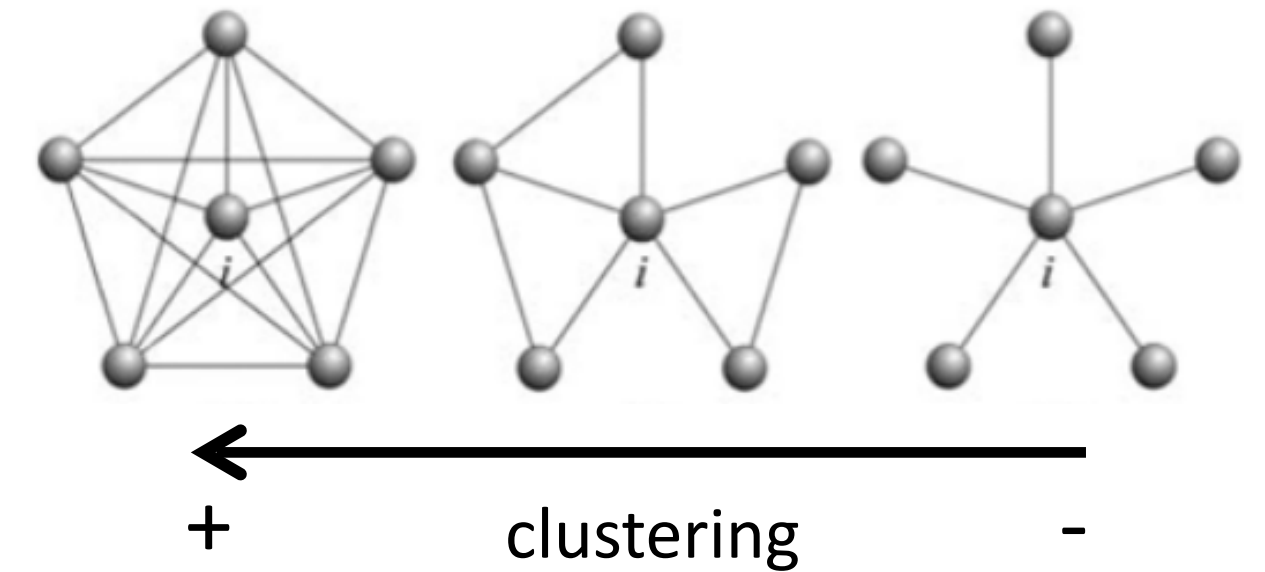
Requisite A. Distance btw sp.

Shortest path among nodes  $i, j$ .



Requisite B. Clustering coefficient

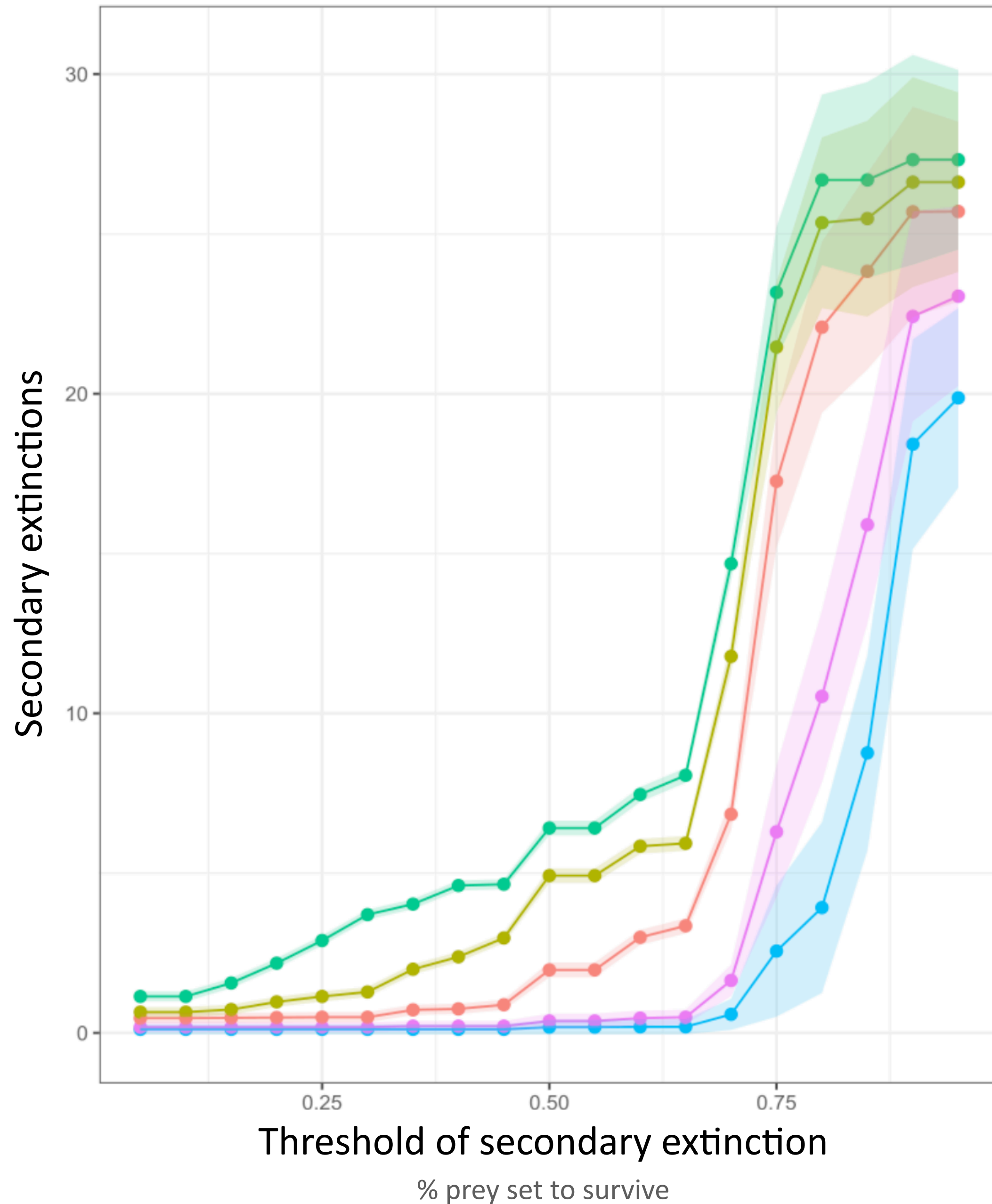
Connectivity among neighbors of node  $i$ .



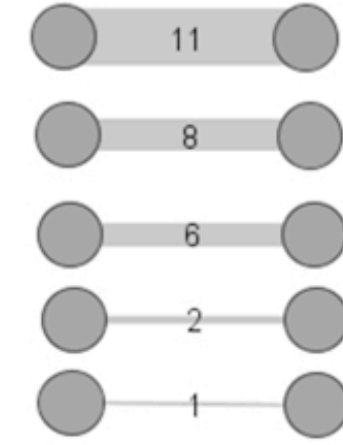
**Not fragile against extinction of most-connected sp.**

**Rapid spread of a perturbation throughout the network** (Dist btw sp. = 1.82).

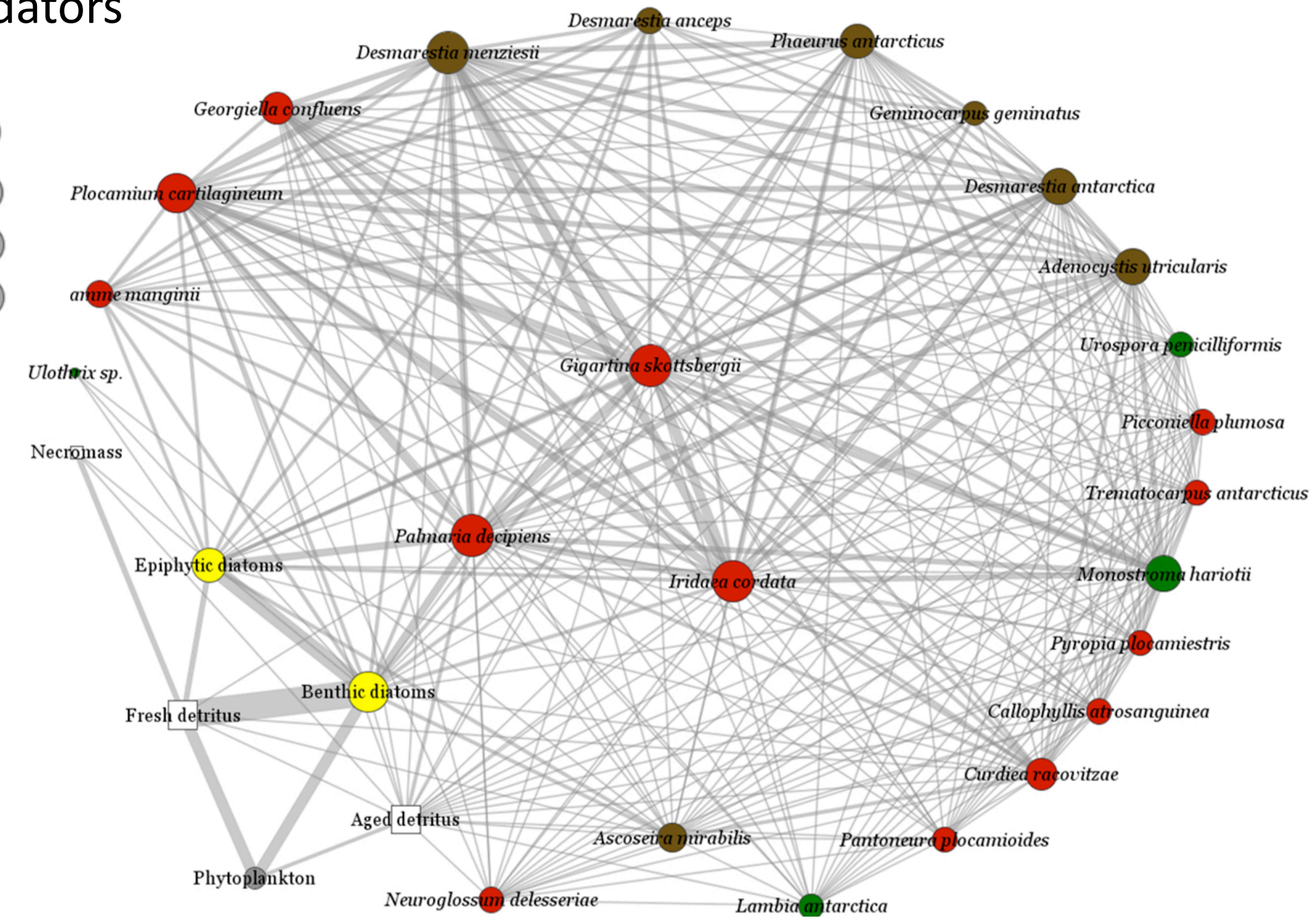
# Finding 3: Potter Cove food web is robust to macroalgae perturbations, but...



# shared predators



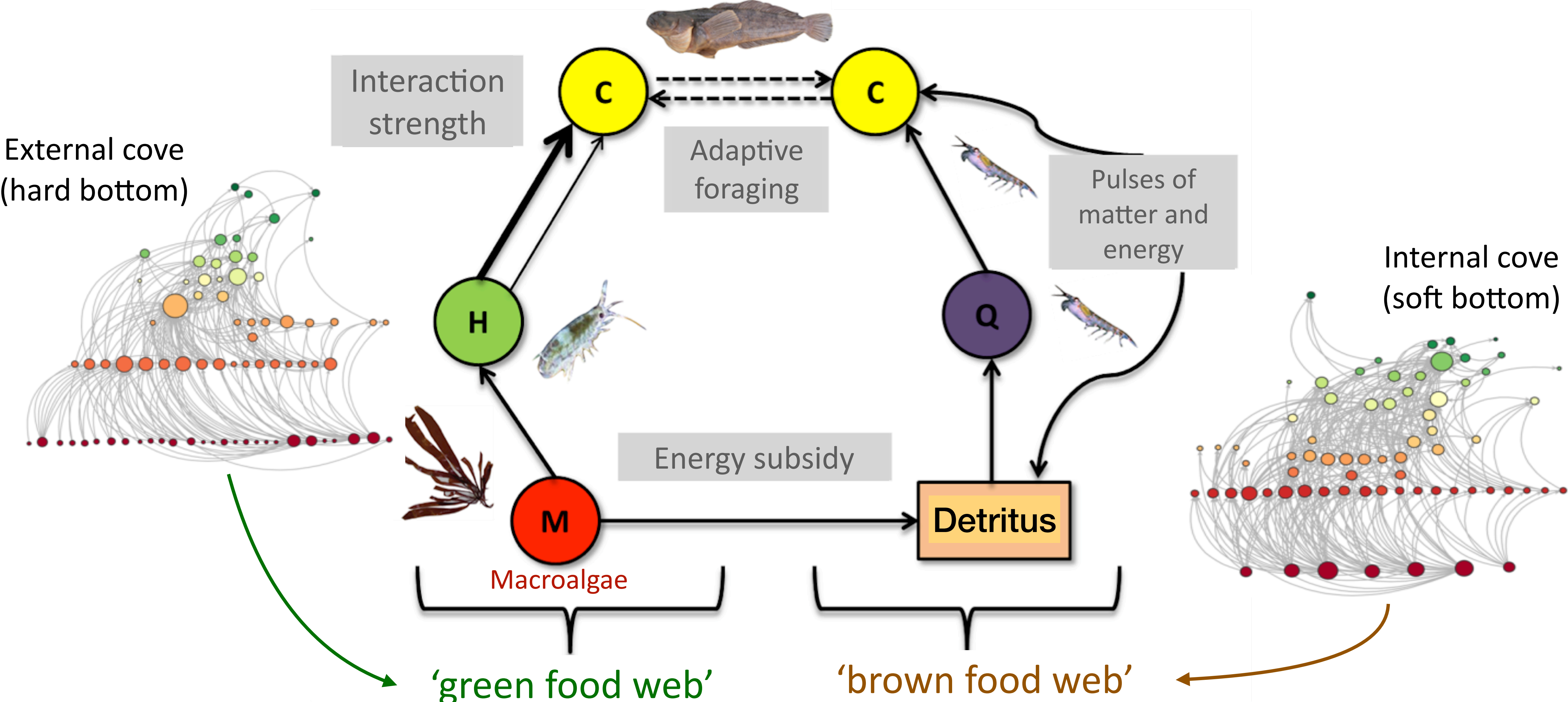
macroalgae extinctions



Robustness due to functional redundancy

Changes might not be detected until most of the macroalgae species are affected

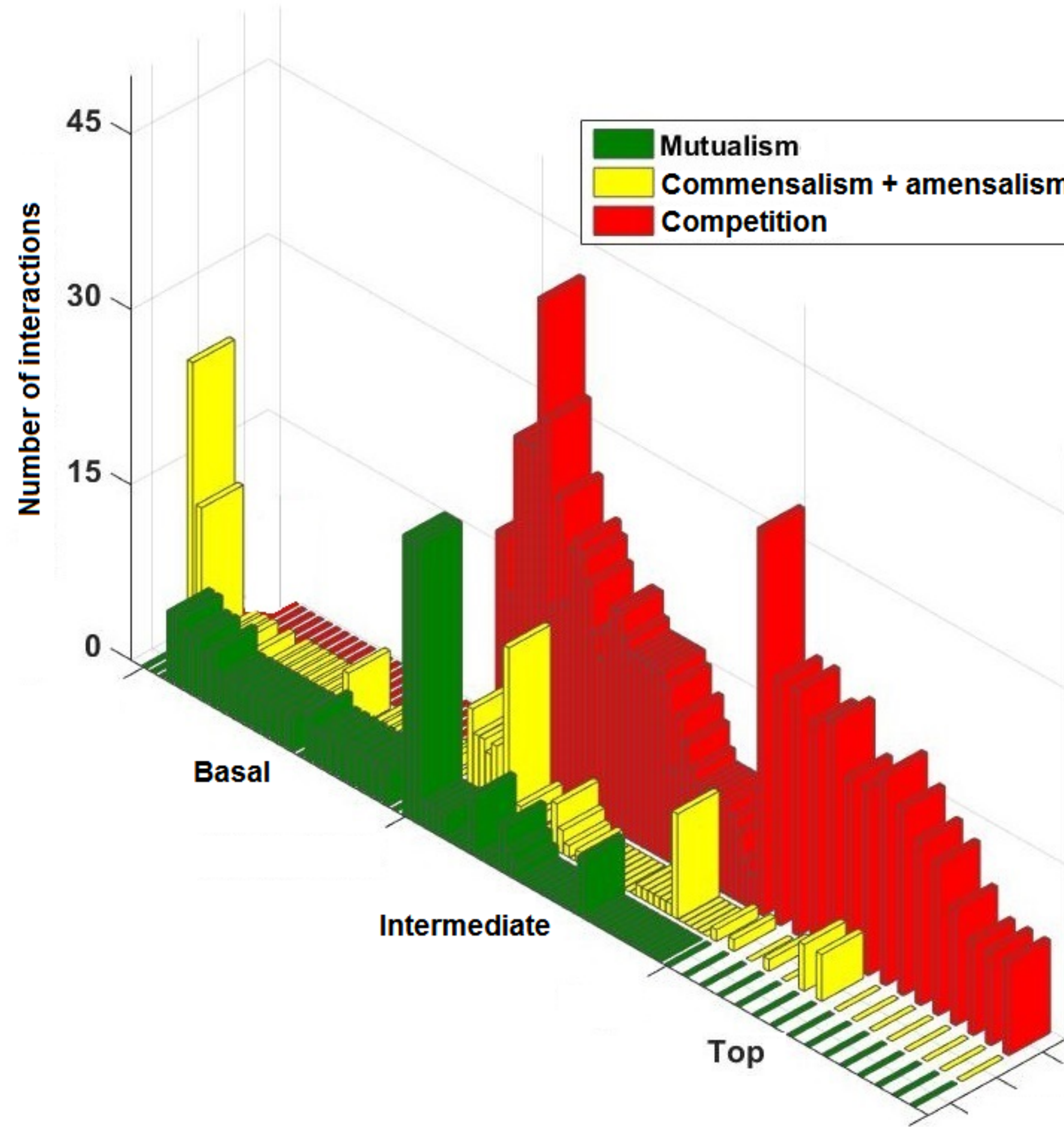
# Finding 4: Potter Cove ecosystem functions as a 'green' and 'brown' food web





# Finding 5: Non-trophic interactions prevail in Potter Cove ecosystem

- Mutualism (+/+)
- Commensalism (+/0)
- Amensalism (-/0)
- Competition (-/-)



Amphipods and Macroalgae

Epiphytic microalgae on Ascidians

Fish & Amphipods diet overlap

## Take home message

The network perspective arises as a powerful approach to comprehend the structure and dynamics of WAPSA marine ecosystems and, as a consequence, to analyze the impacts of climate change on them.

## Forum discussion

Is there a common response pattern in WAPSA systems to climate change?  
The network approach might be a suitable framework to tackle this.

Thank you!

Tomás I. Marina  
[tomasimarina@gmail.com](mailto:tomasimarina@gmail.com)

Georgina Cordone

Vanesa Salinas

Iara D. Rodríguez

Santiago R. Doyle

Fernando R. Momo

Leonardo A. Saravia