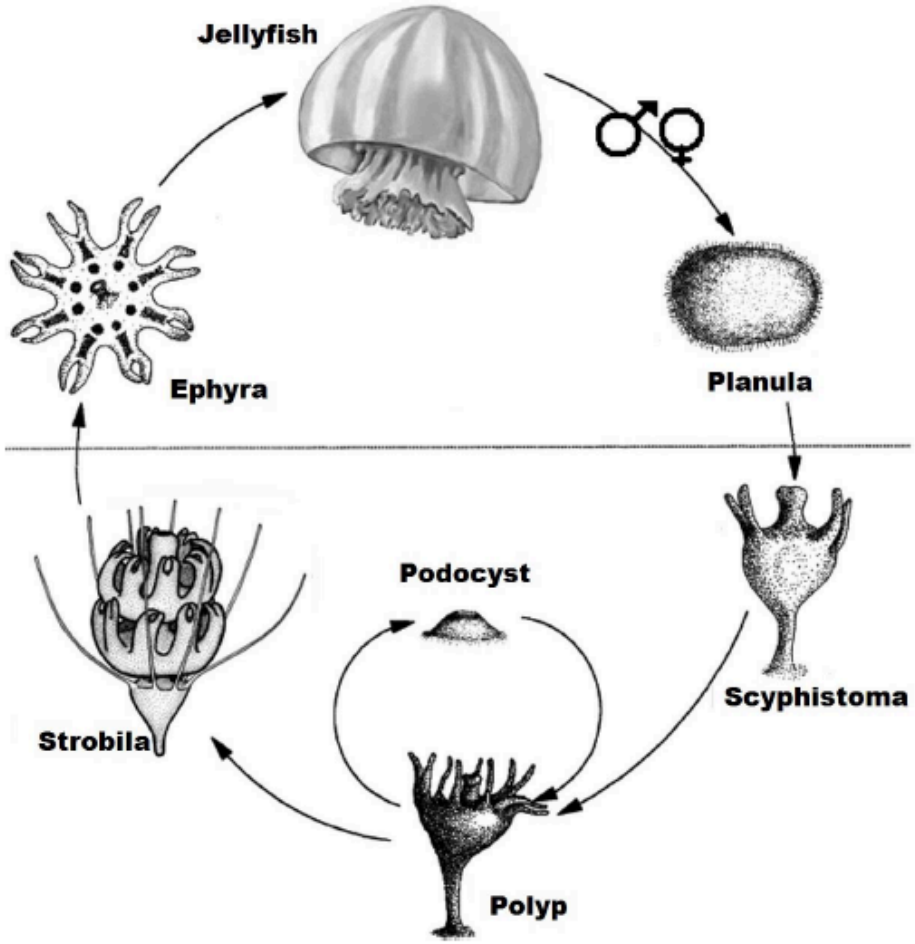
Are our oceans turning into jelly? The effect of climate change on gelatinous zooplankton

Natasha Henschke
Princeton University

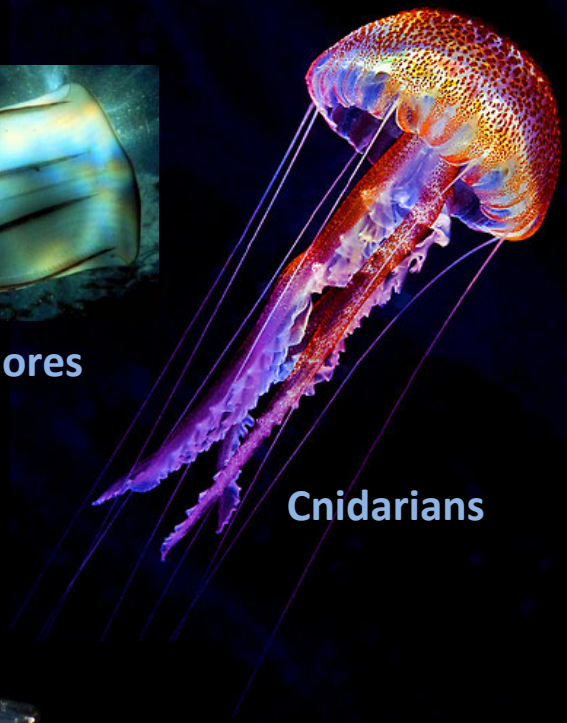
Future work with Nereus

- Examine and model global relationships between climate and jellyfish blooms
- Explore the global role of gelatinous zooplankton within planktonic food webs



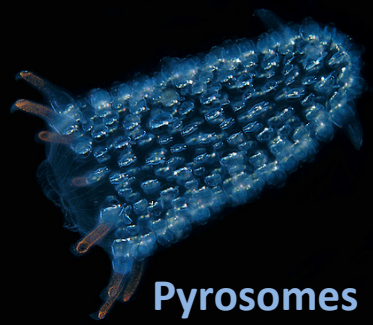
Swarming species

Ctenophores



Cnidarians

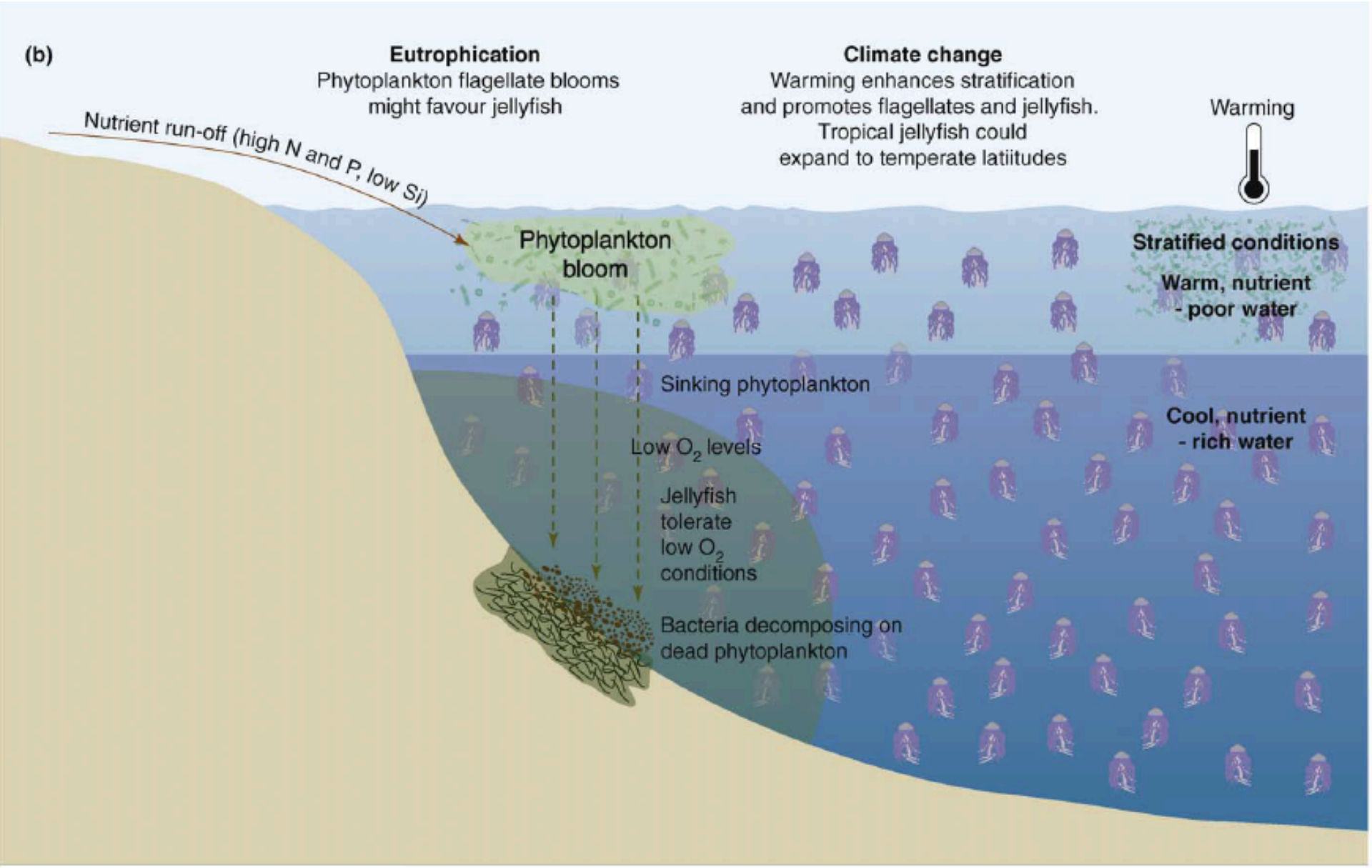
Salps



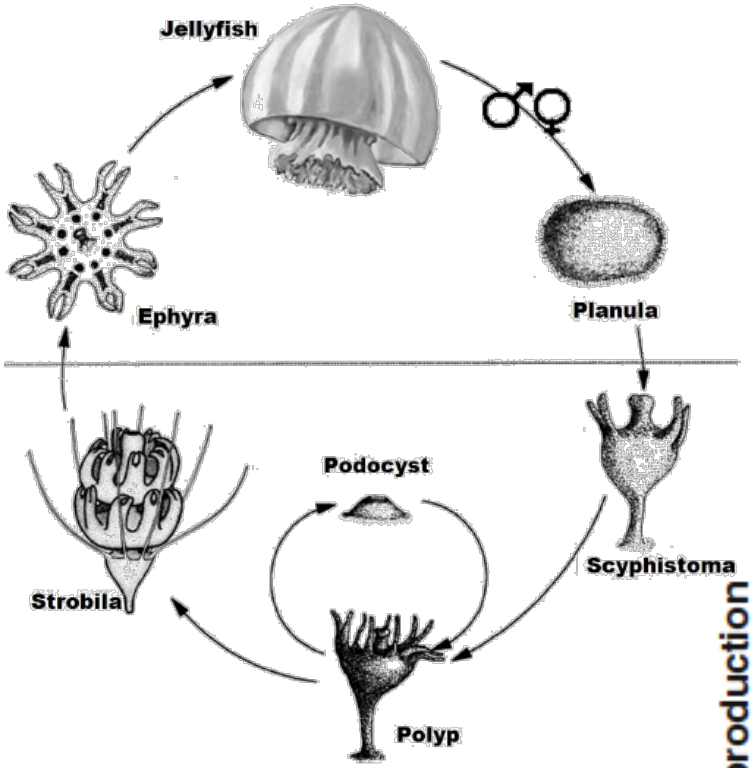
Pyrosomes


エチゼンクラゲが日本に流れつくルート
エチゼンクラゲの
本来の生息域
渤海
黄海
東シナ海
対馬暖流

Potential impact of climate change

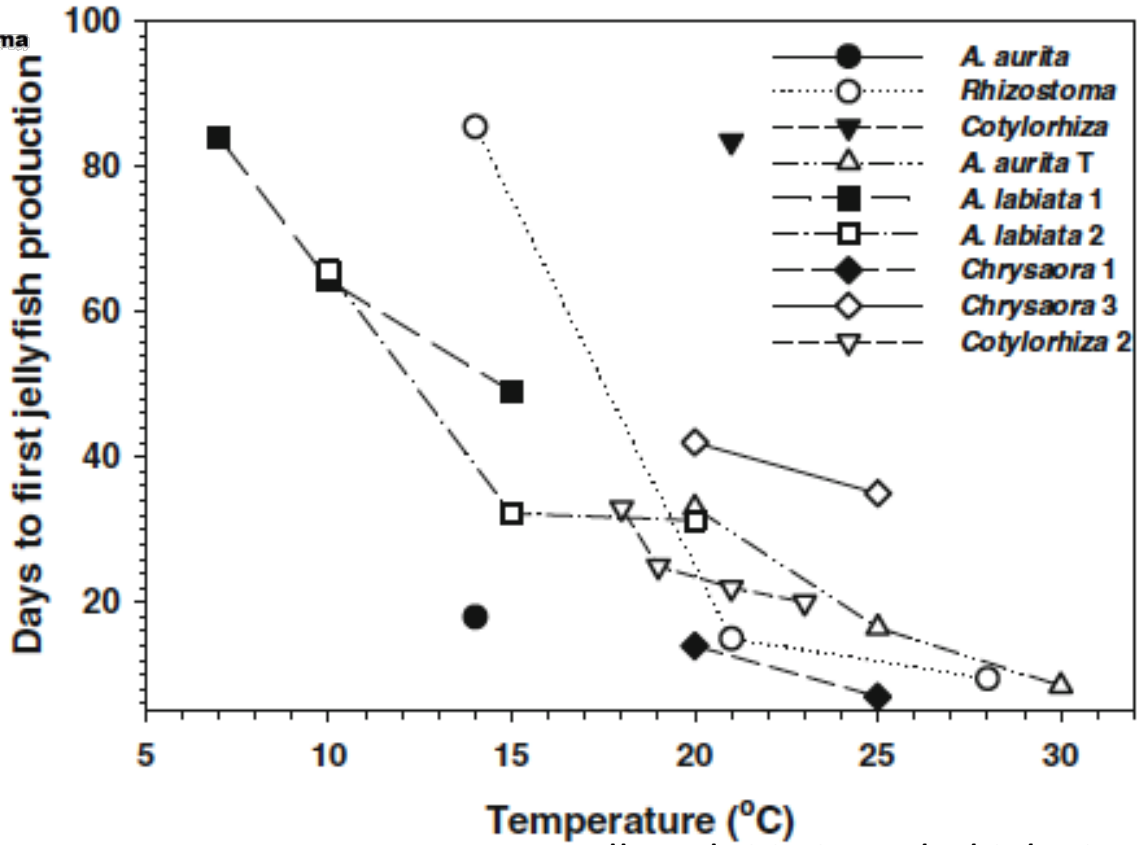


Richardson et al. 2009, *TREE*

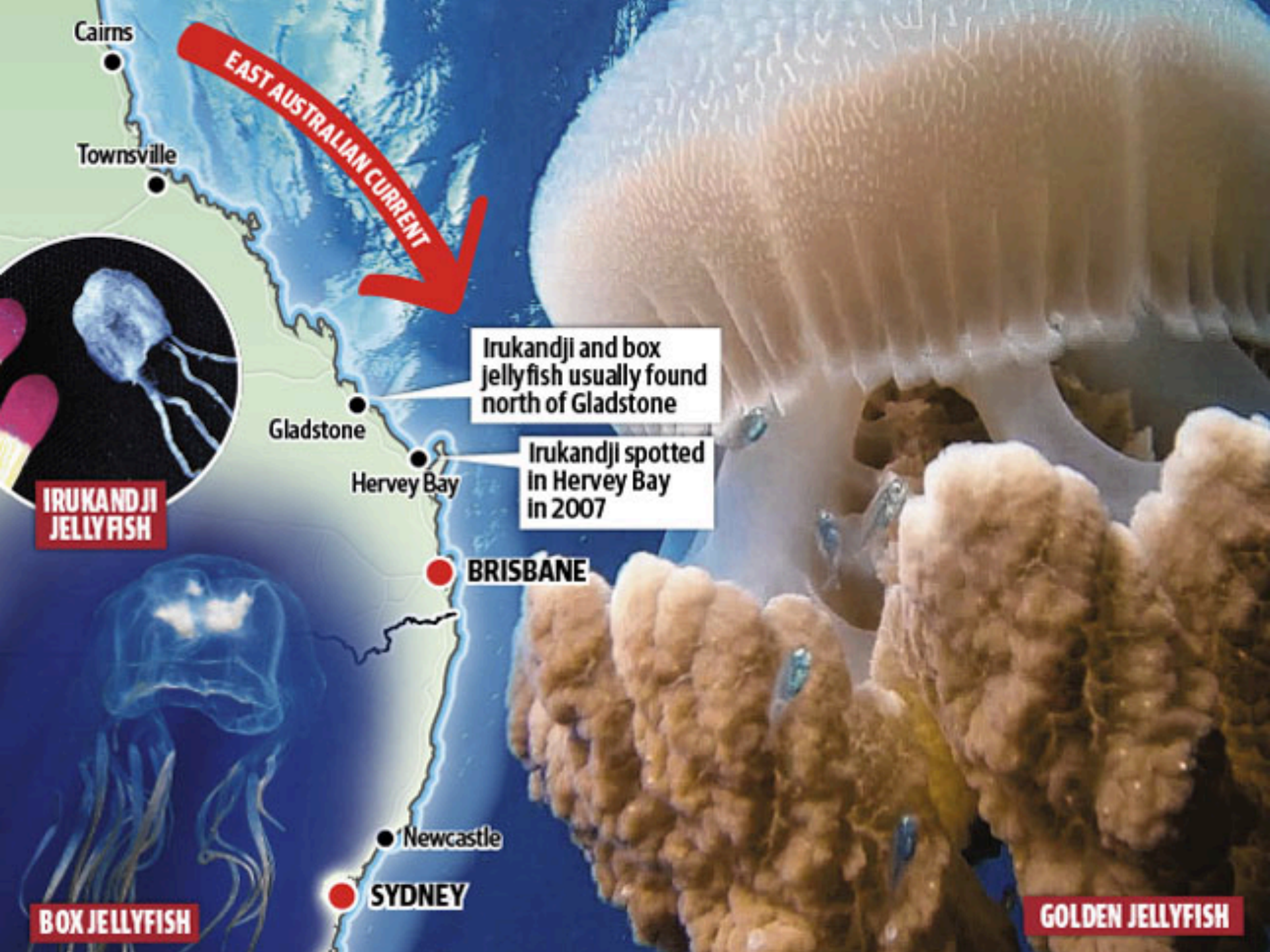


Increasing temperature will:

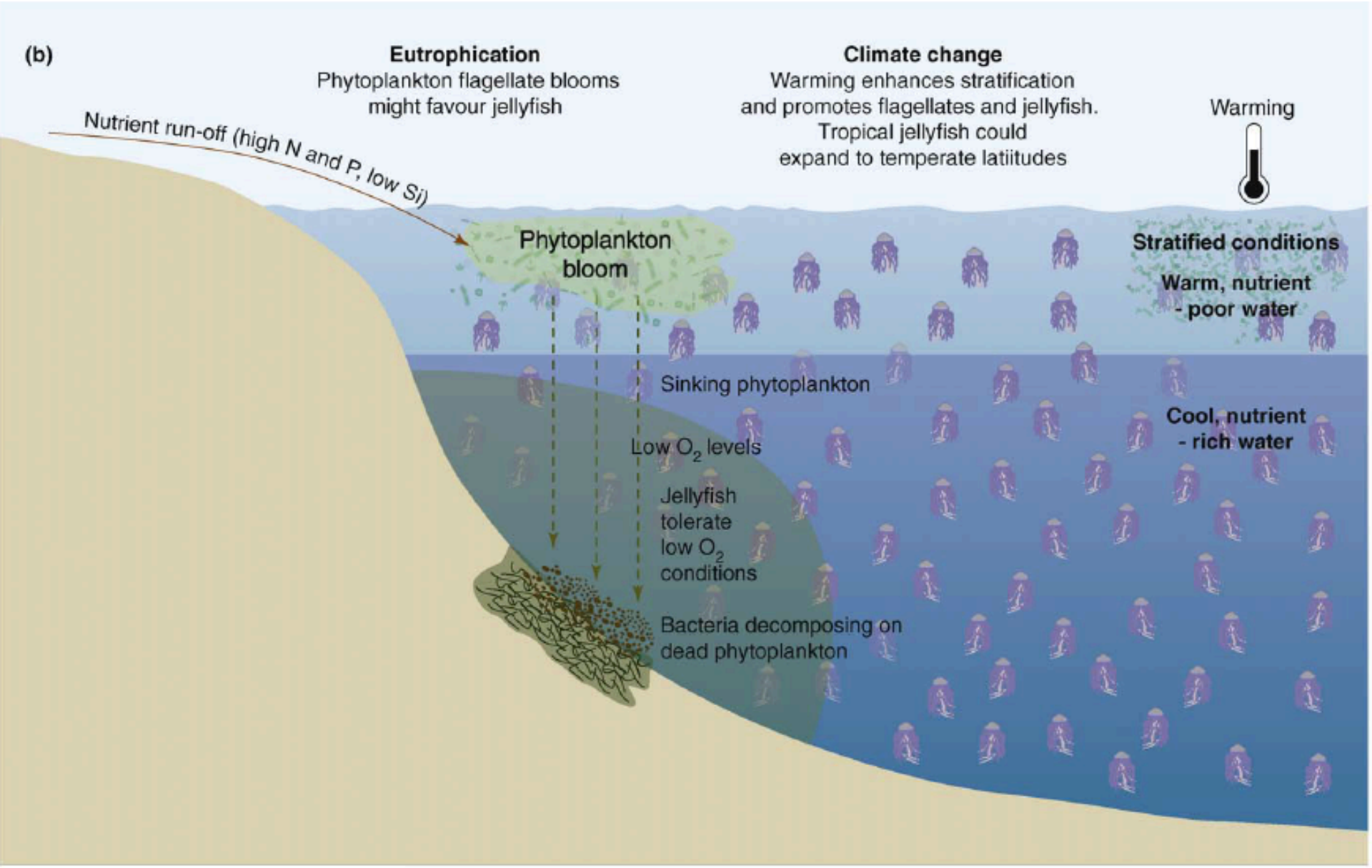
- Accelerate medusae growth
- Accelerate ephyrae production
- Lengthen reproductive season



Purcell et al. 2012, *Hydrobiologia*

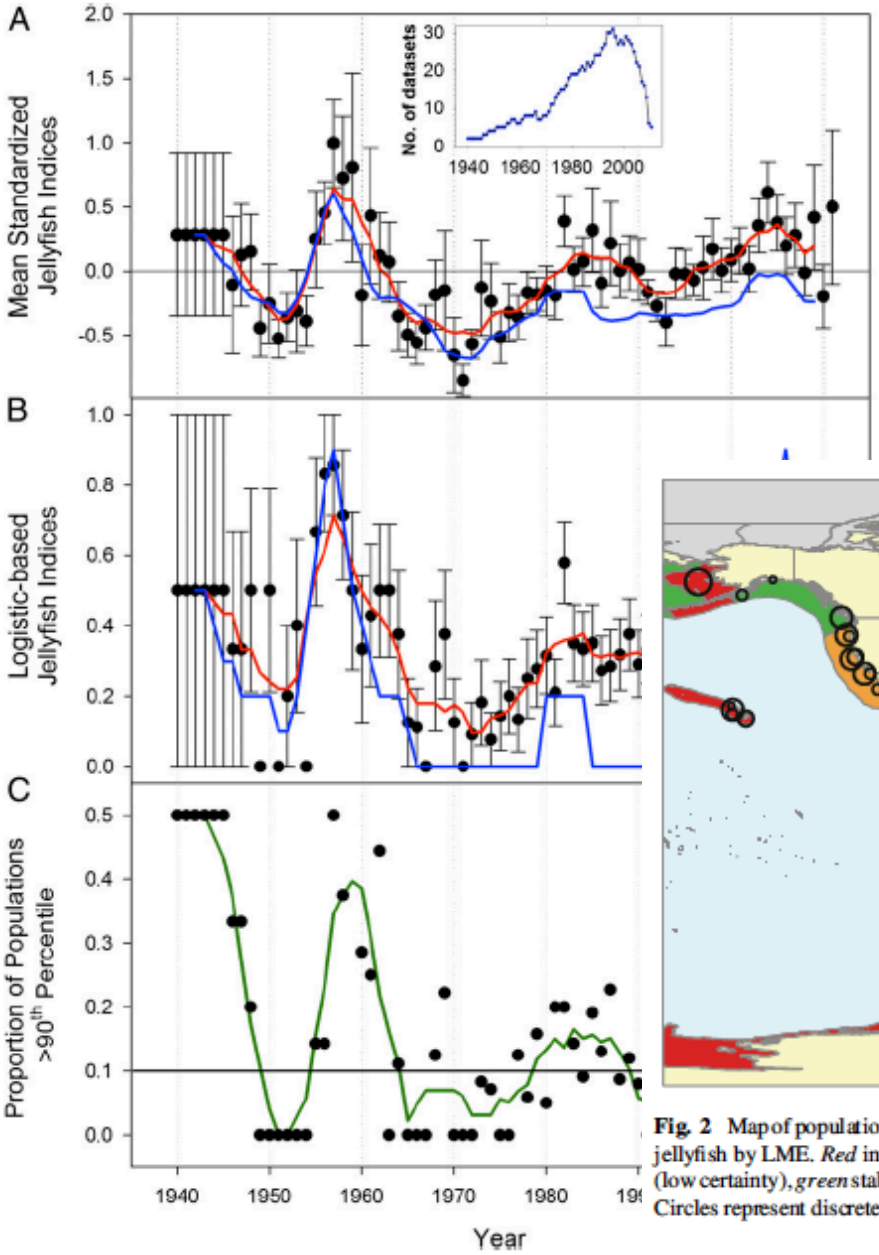

Cairns
Townsville
EAST AUSTRALIAN CURRENT
Irukandji and box jellyfish usually found north of Gladstone
Gladstone
Irukandji spotted in Hervey Bay in 2007
Hervey Bay
IRUKANDJI JELLYFISH
BRISBANE
Newcastle
SYDNEY
BOX JELLYFISH
GOLDEN JELLYFISH

Potential impact of climate change

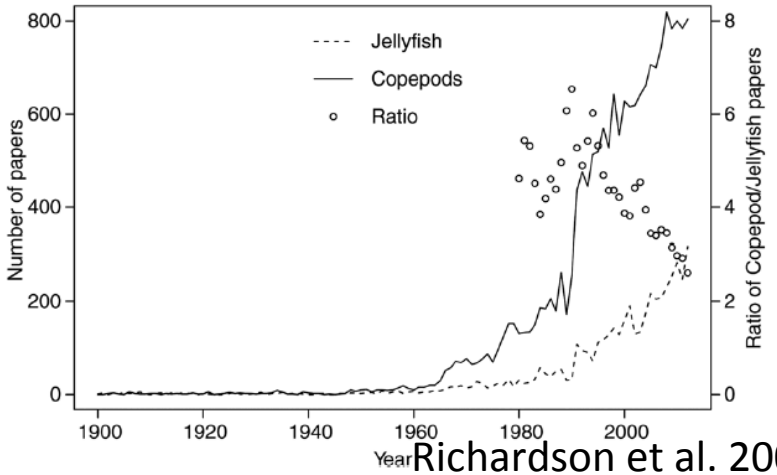


Richardson et al. 2009, *TREE*

Are gelatinous zooplankton increasing?



Condon et al. 2013, *PNAS*



Richardson et al. 2009, *TREE*

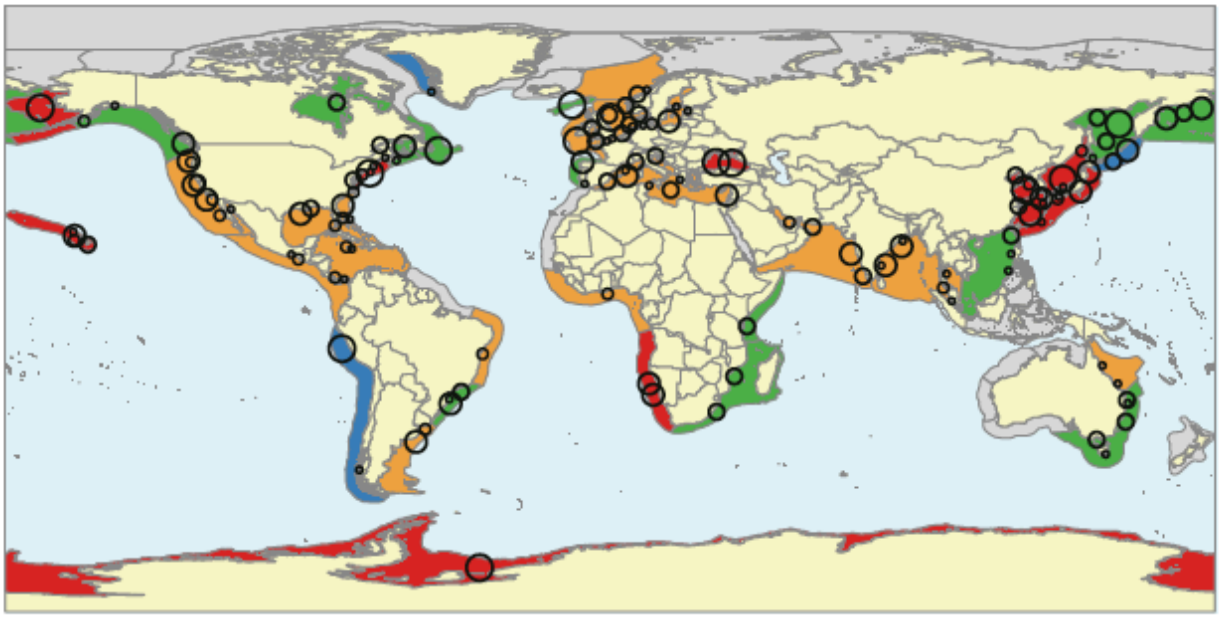
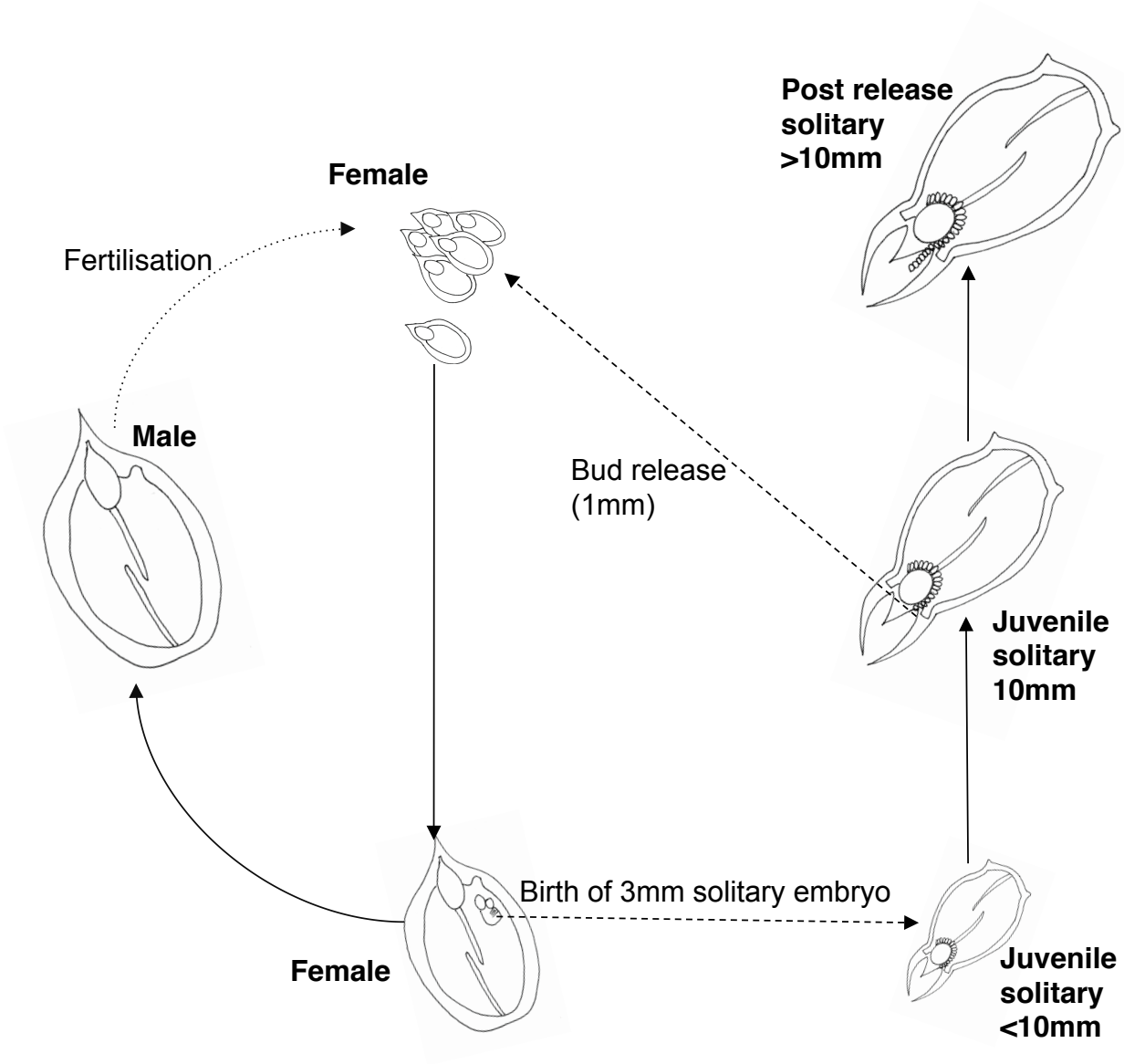
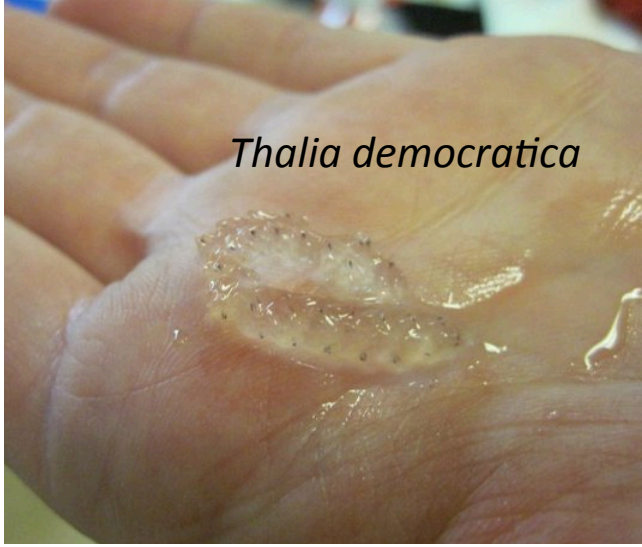


Fig. 2 Map of population trends of native and invasive species of jellyfish by LME. *Red* increase (high certainty), *orange* increase (low certainty), *green* stable/variable, *blue* decrease, *grey* no data. Circles represent discrete chronicles with relative sizes reflecting the Confidence Index. Circle locations are approximate, as some were shifted to avoid overlap; the circle for the Antarctic LME summarizes circumpolar observations

Brotz et al. 2012, *Hydrobiologia*

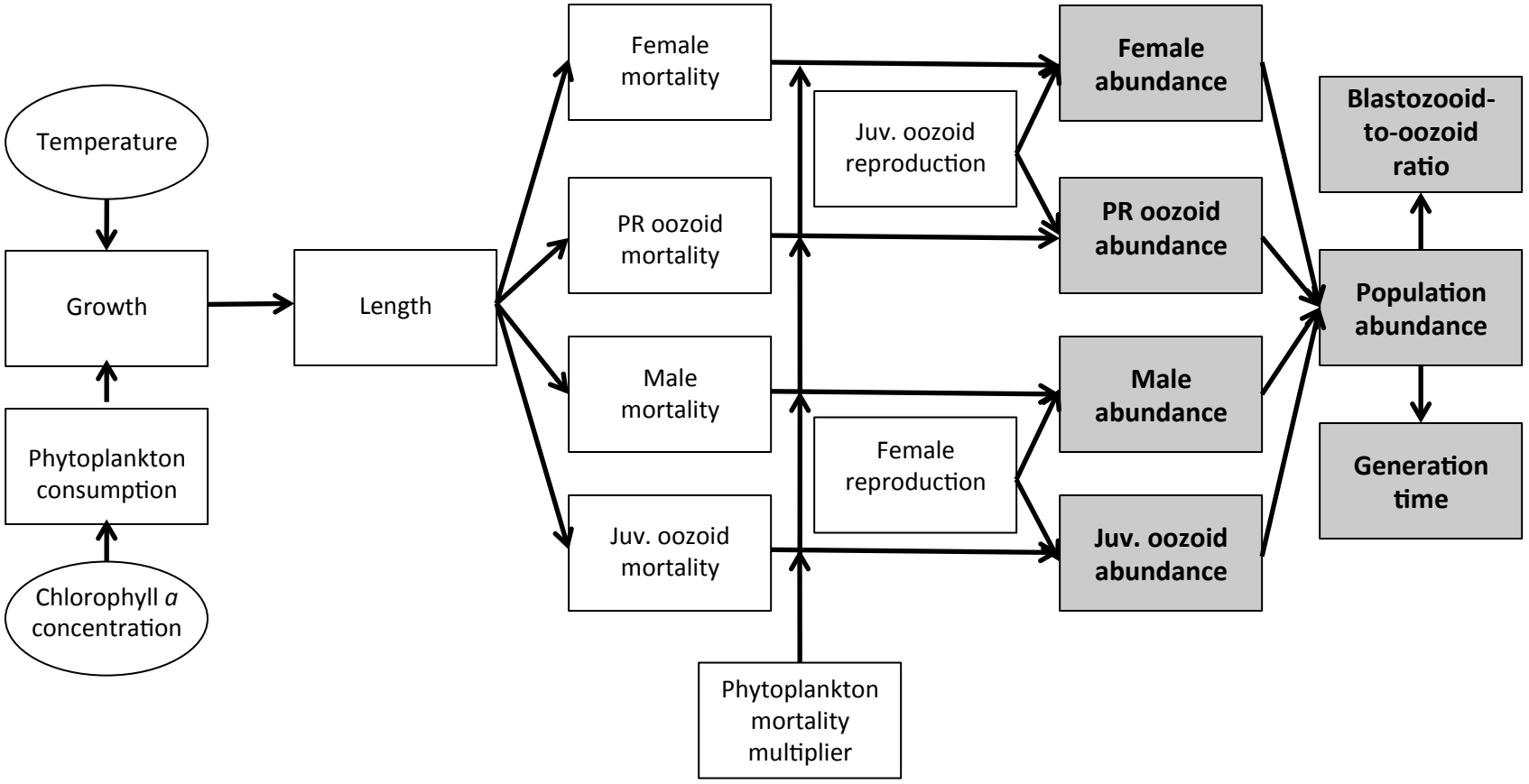
Salp population model



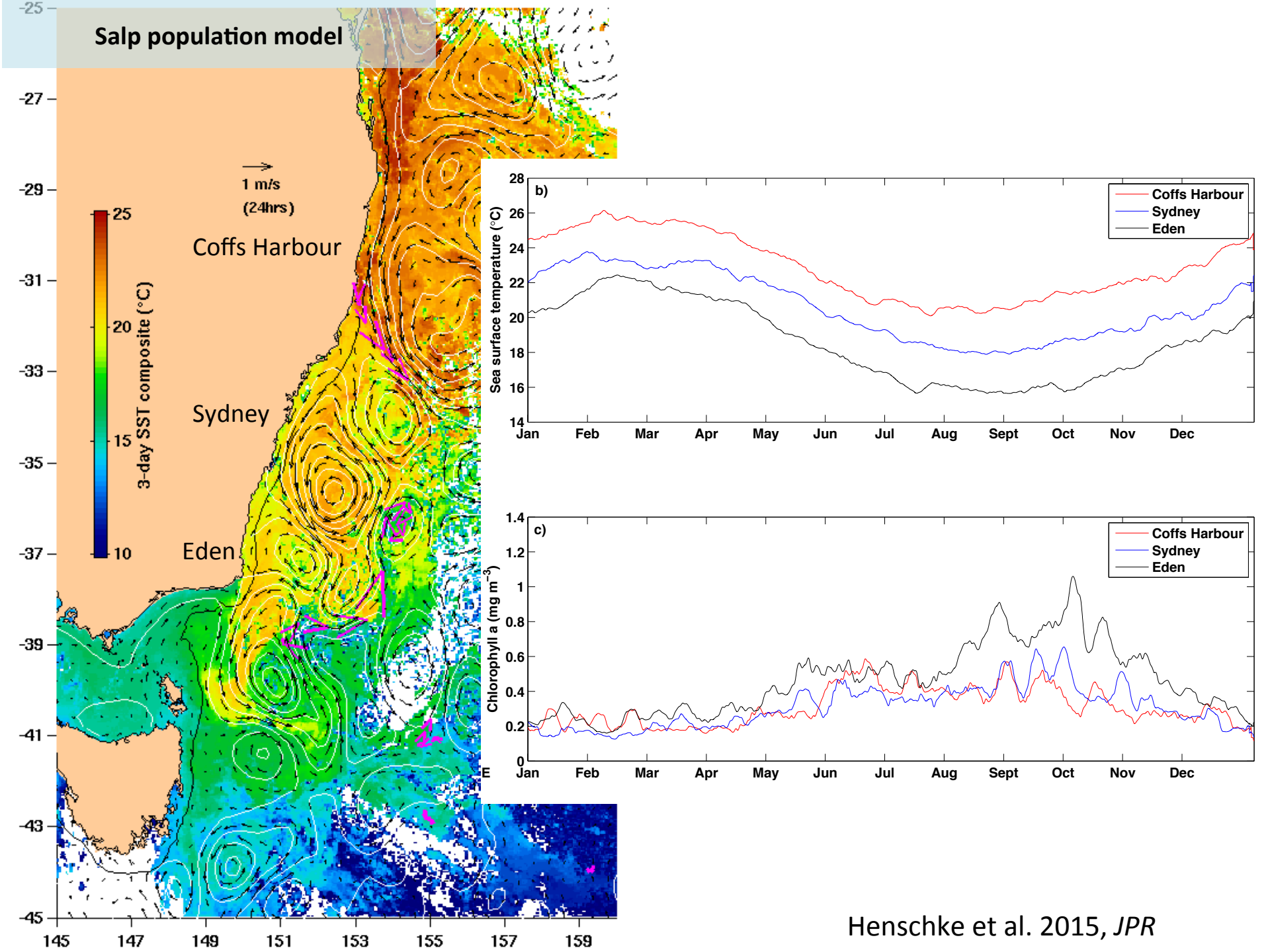


Henschke et al. 2015, *JPR*

Salp population model

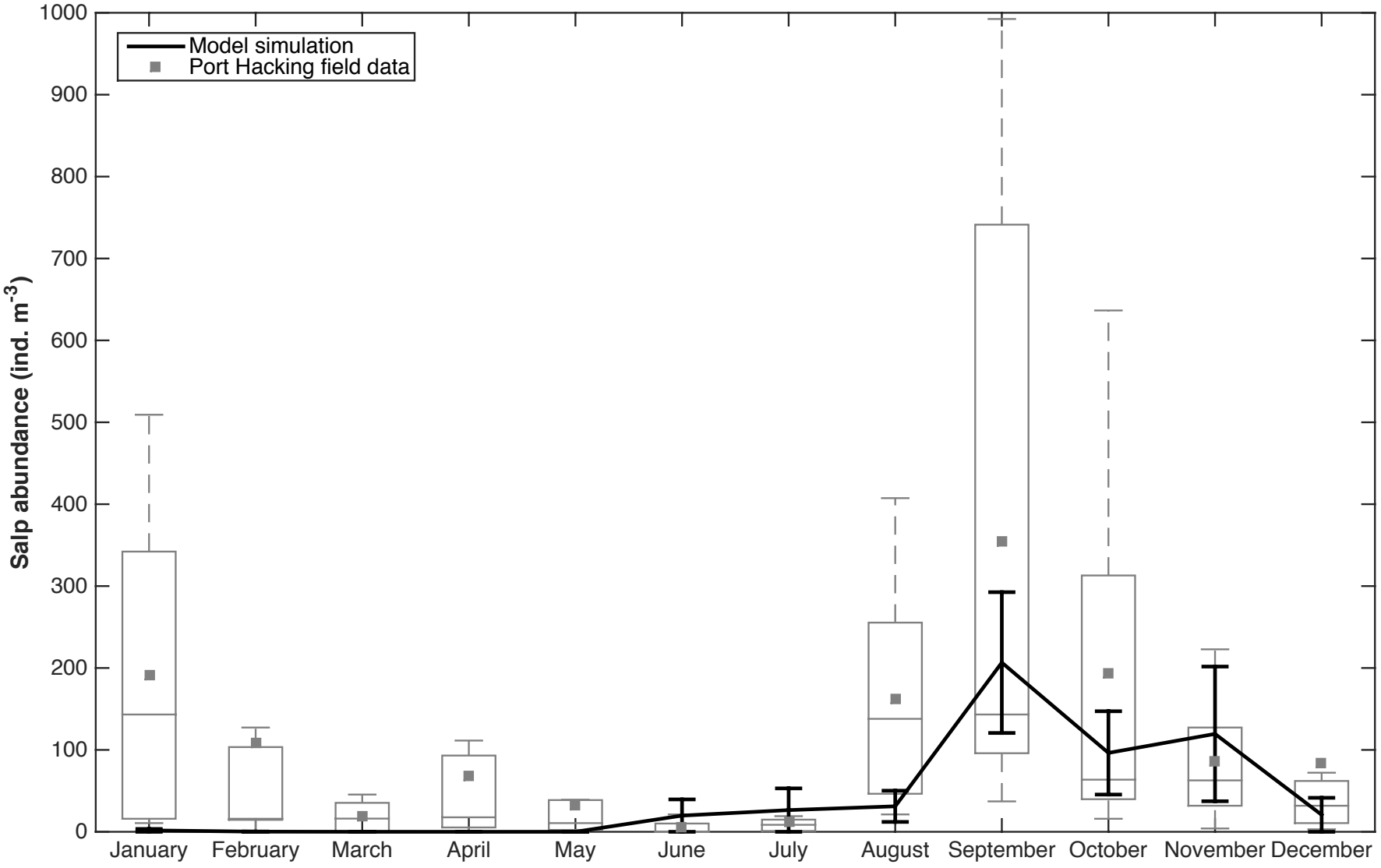


Henschke et al. 2015, *JPR*

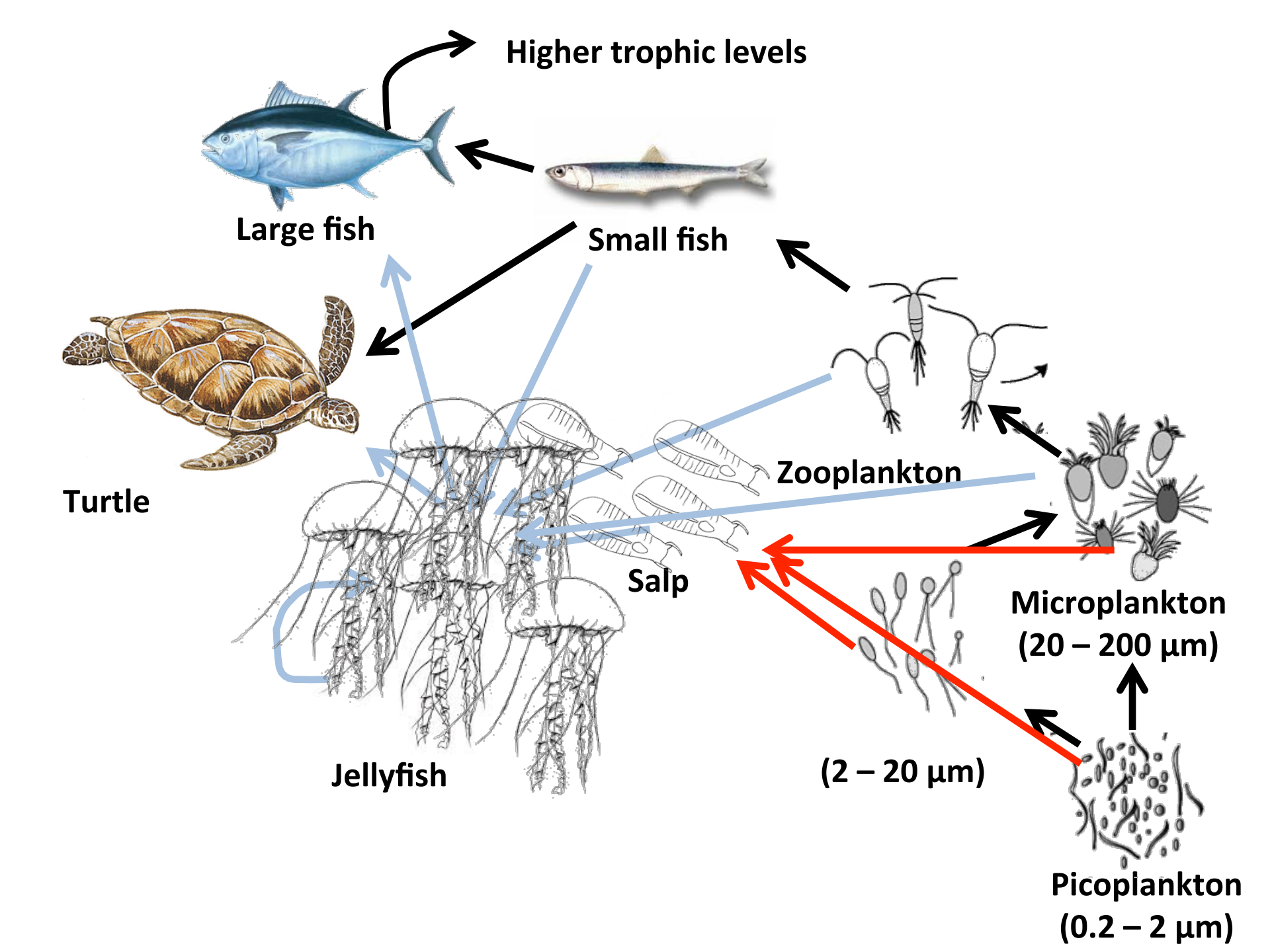


Henschke et al. 2015, *JPR*

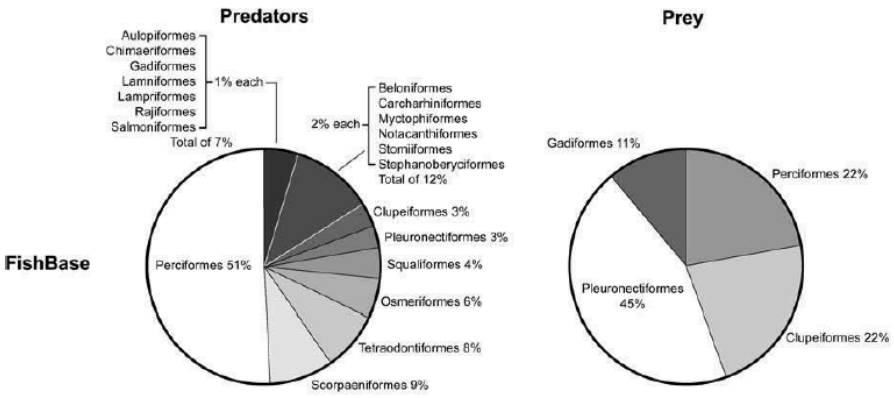
Salp population model



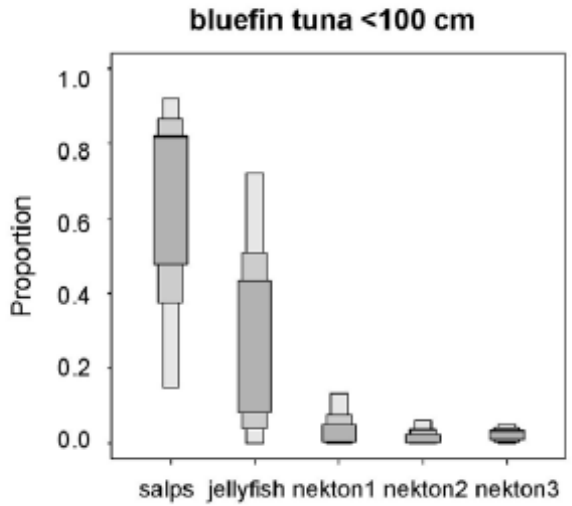
Henschke et al. 2015, *JPR*

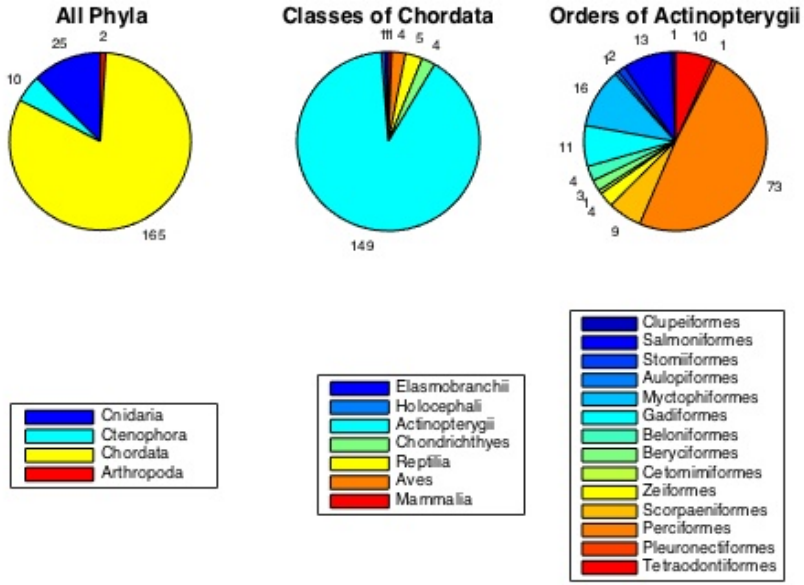

Higher trophic levels
Large fish
Small fish
Turtle
Zooplankton
Salp
Jellyfish
Microplankton
(20 – 200 µm)
(2 – 20 µm)
Picoplankton
(0.2 – 2 µm)

Predators of gelatinous zooplankton

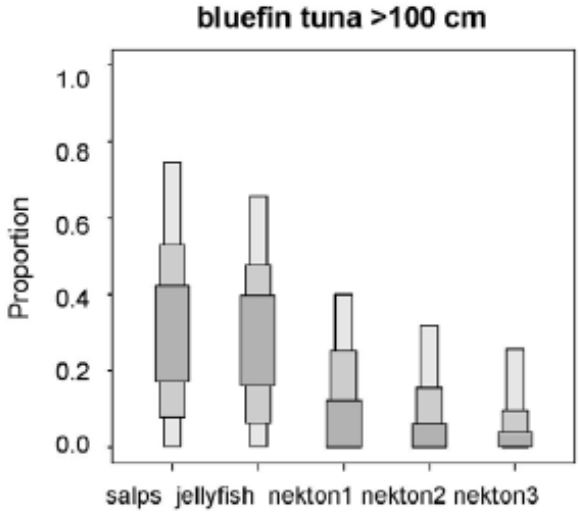


Pauly et al., 2009, *Hydrobiologia*





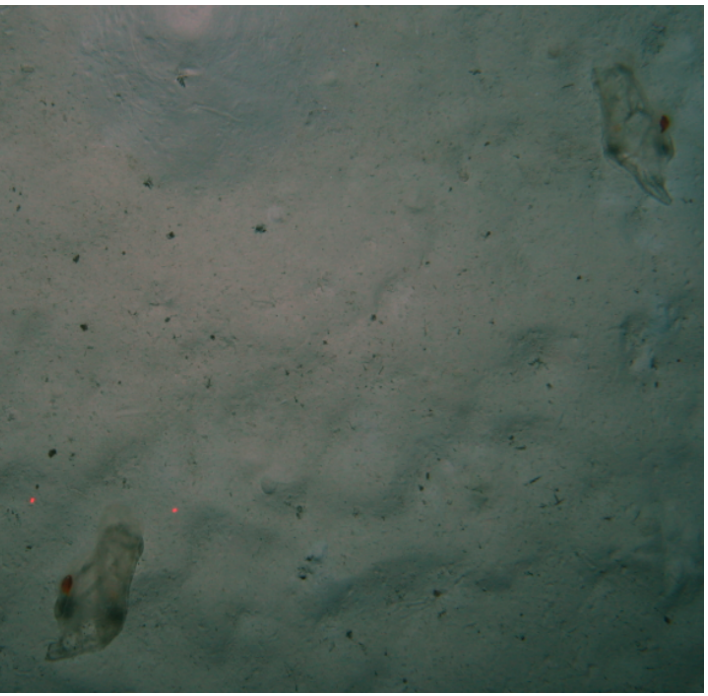
Henschke et al., in prep

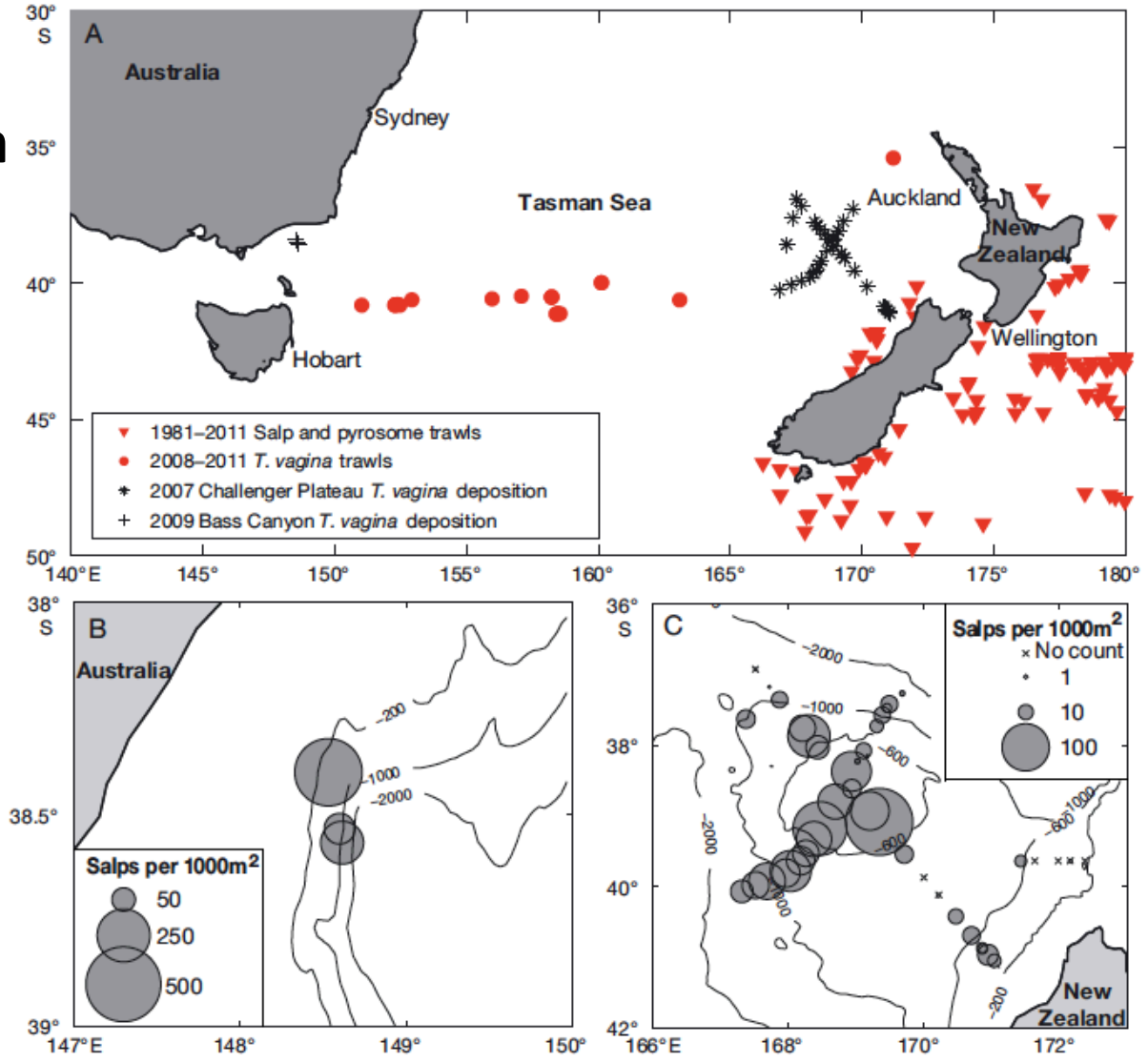


Cardona et al., 2012, *PLoS One*

Mass deposition of salp carcasses in the Tasman Sea

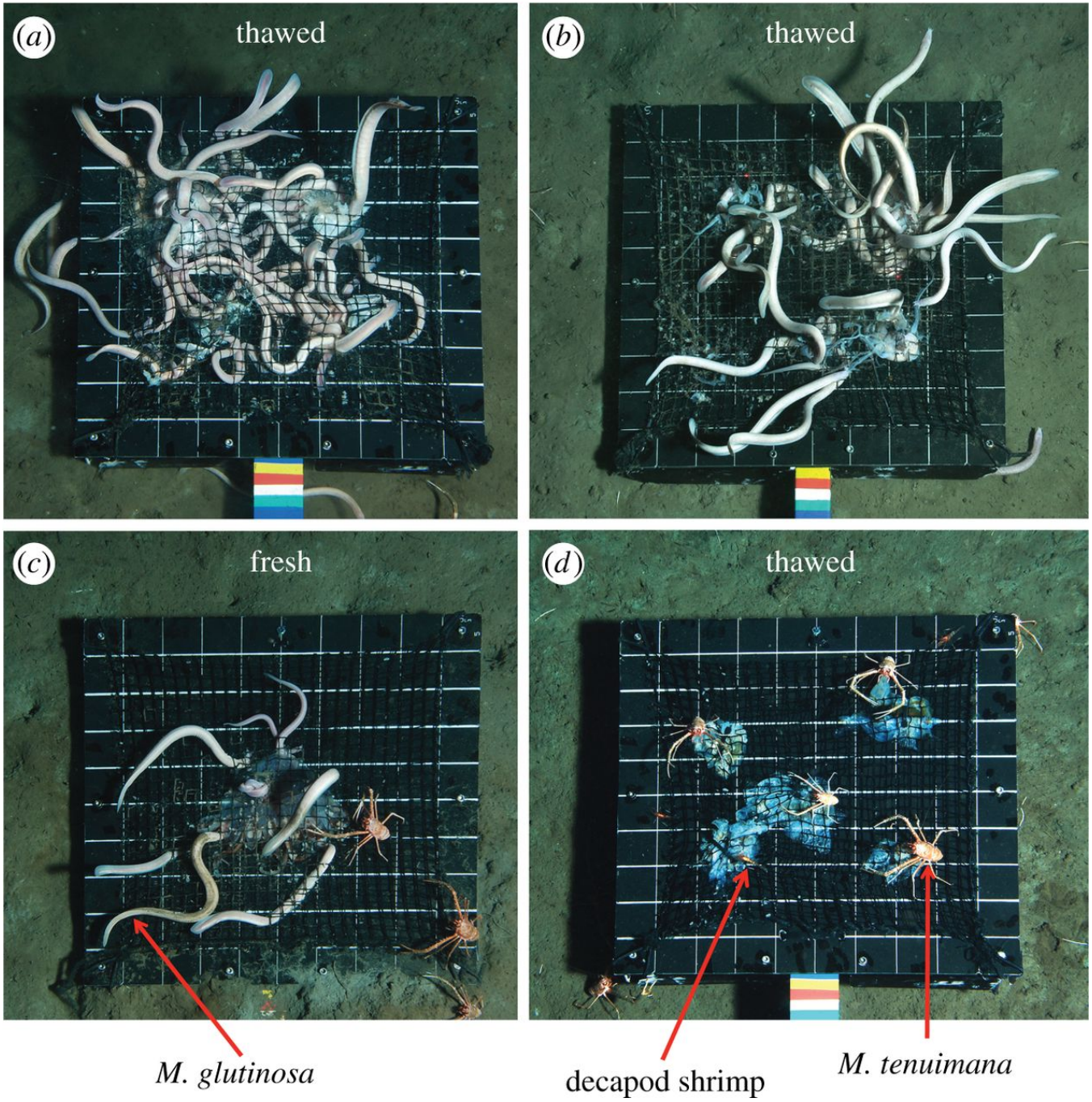
- **1768 individuals**
- **Sinking rates of 1700 m day^{-1}**
- **32% decomposition after 30 days**





Henschke et al 2013, *MEPS*

Henschke et al 2013, *MEPS*

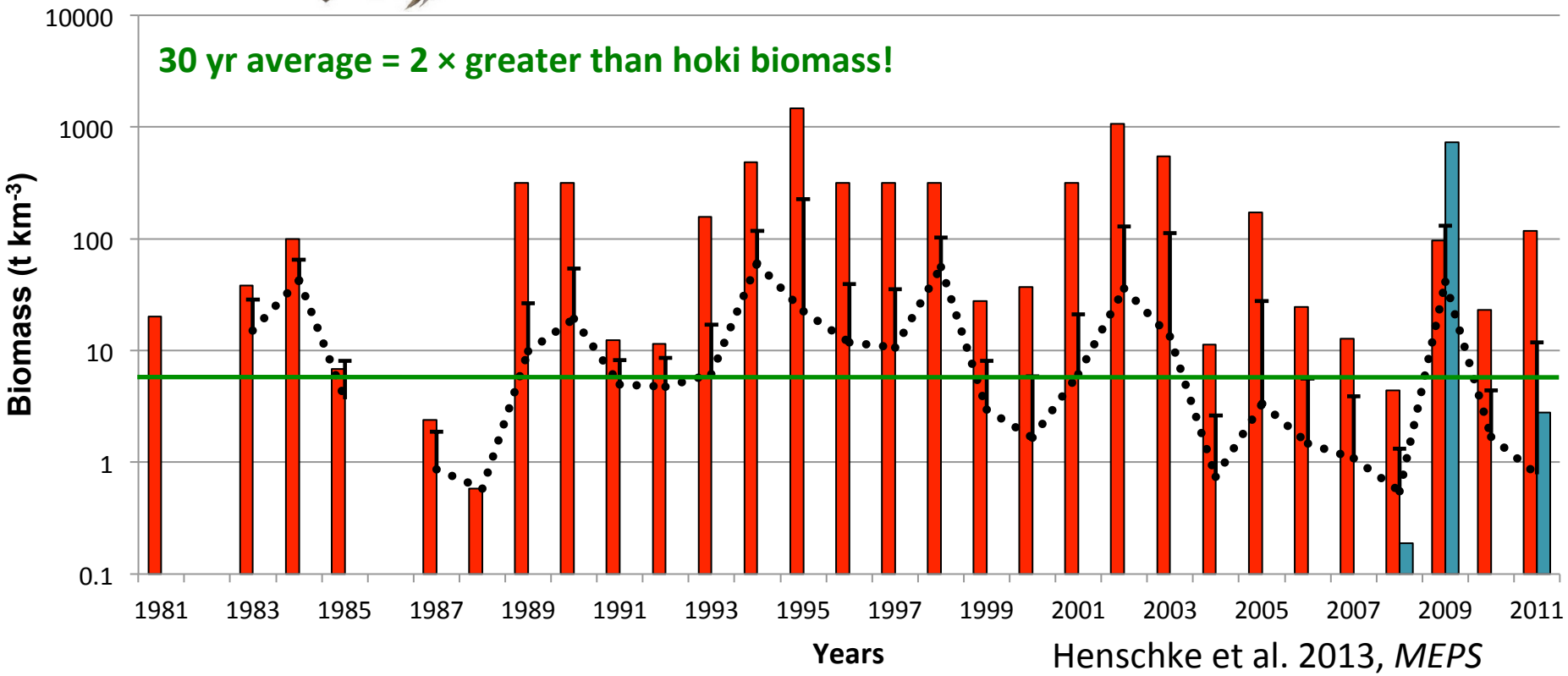


Sweetman et al. 2014, *Proc. R. Soc. B*

New Zealand's #1 fisheries species

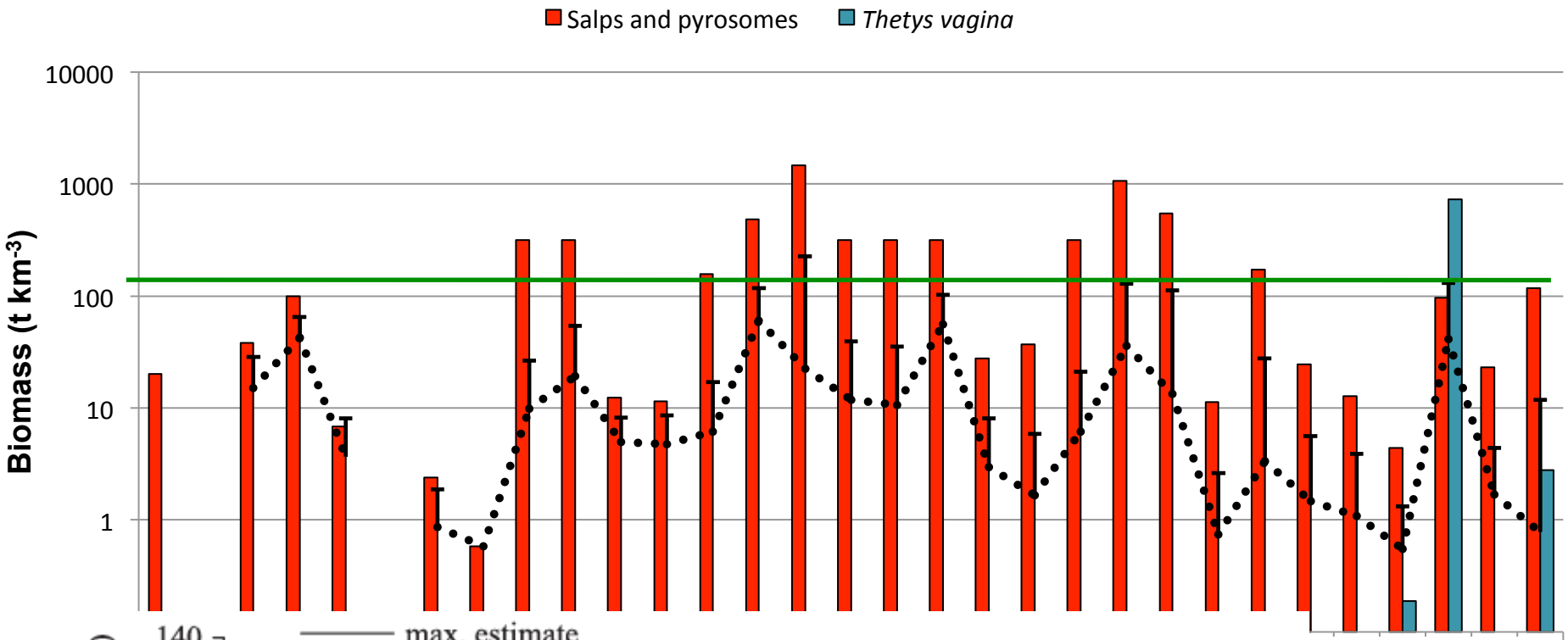
Salps and pyrosomes *Thetys vagina*

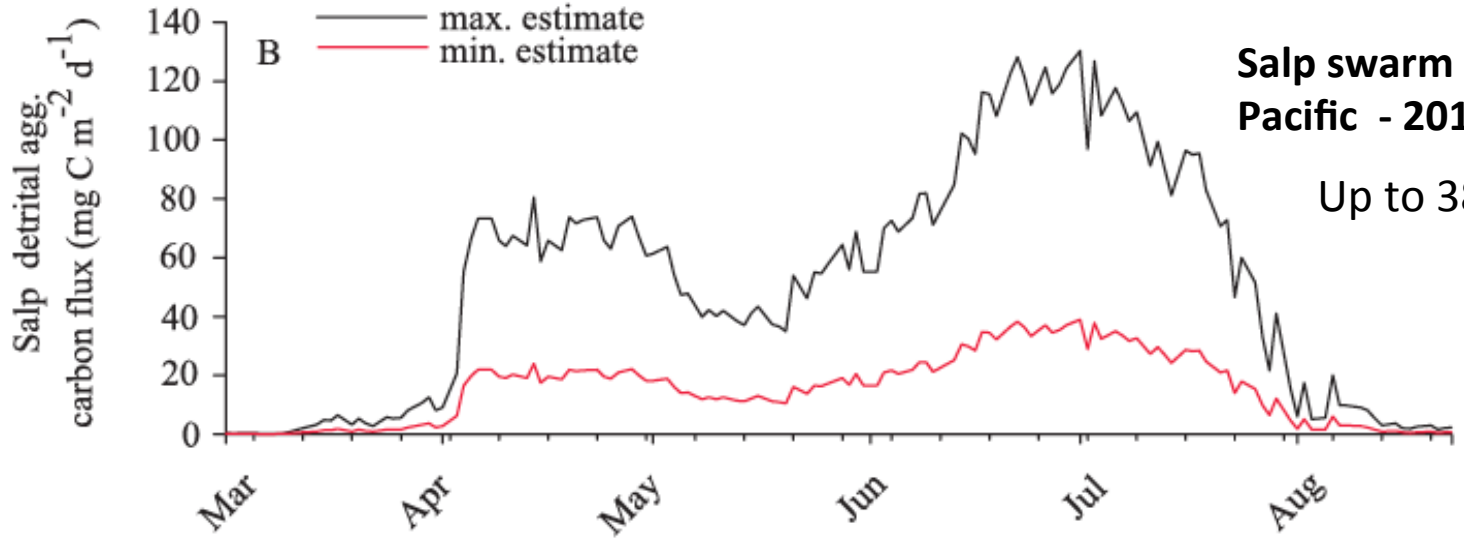
30 yr average = 2 × greater than hoki biomass!



Henschke et al. 2013, *MEPS*

Using 100 t km^{-3}... 16 t C km^{-2} = 10 x annual flux



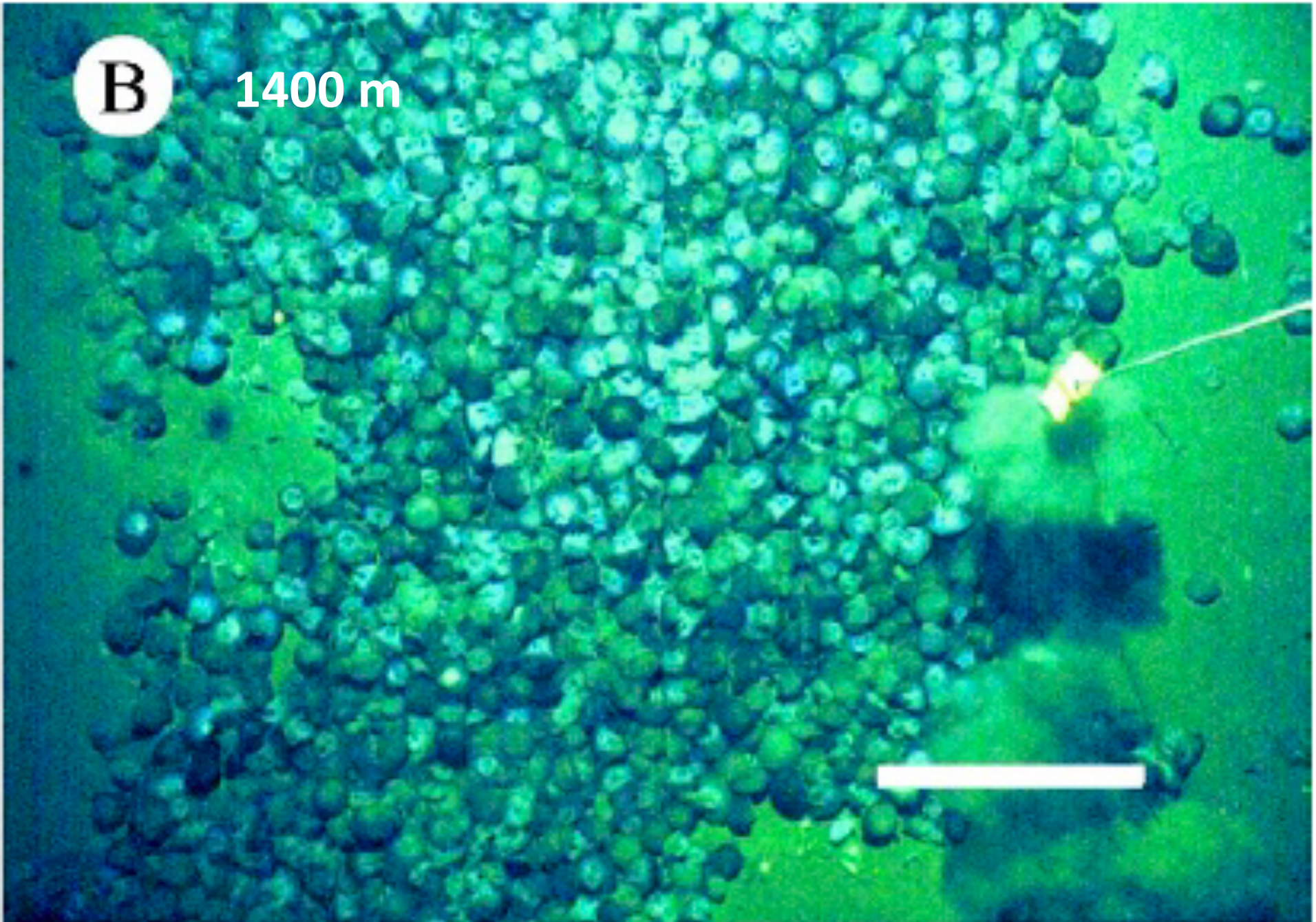


Salp swarm in the North Pacific - 2012

Up to 38 mg C d^{-1}

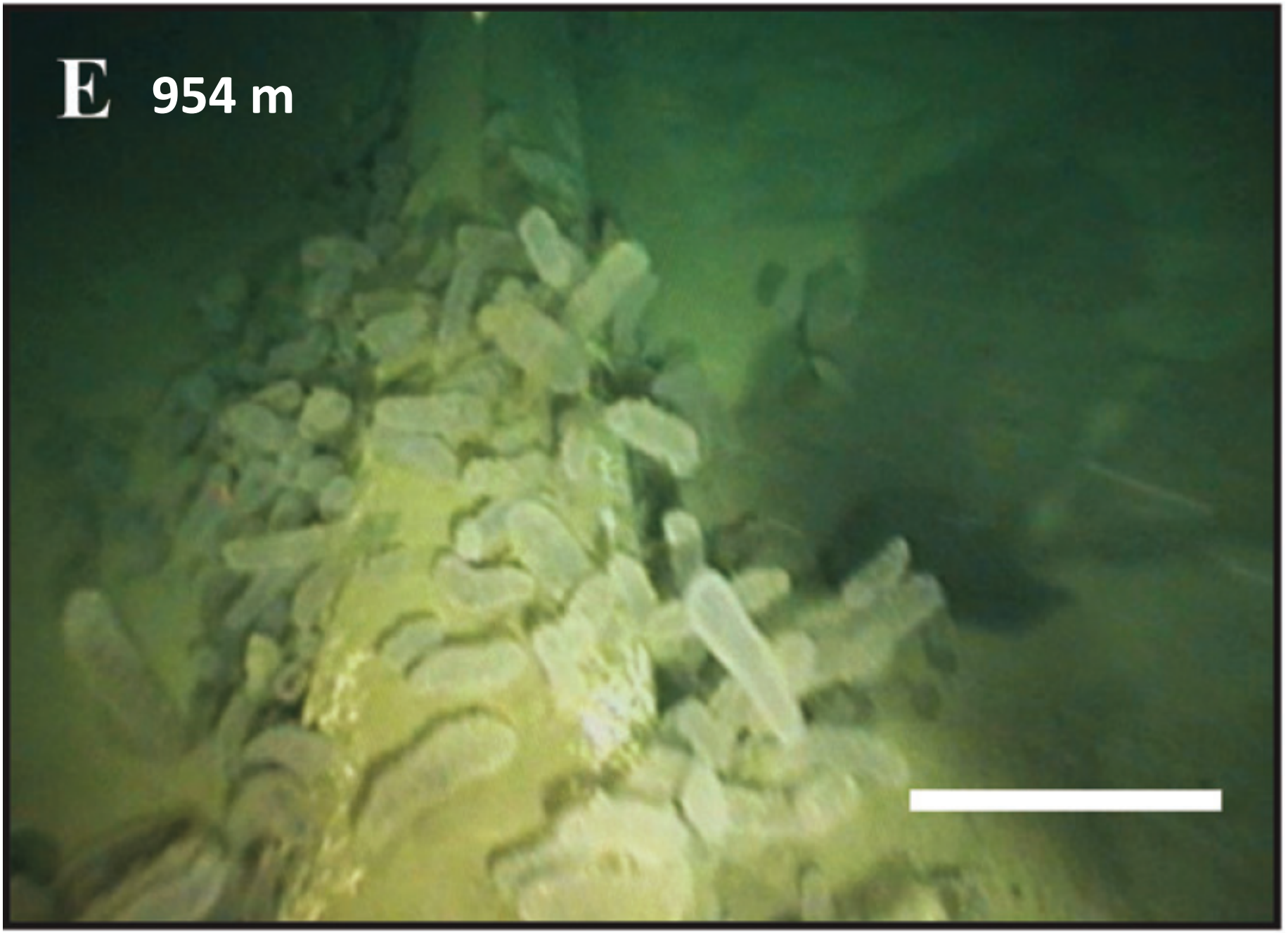
Smith et al. 2014, *L&O*

Crambionella orsini in the Arabian Sea (Billett et al, 2006)



Nemopilema nomurai in the Sea of Japan (Yamamoto et al, 2008)

Pyrosoma atlanticum off Ivory Coast (Lebrato and Jones, 2009)



Future work with Nereus

- Examine and model global relationships between climate and jellyfish blooms
- Explore the global role of gelatinous zooplankton within planktonic food webs


Thank you!