Zooplankton grazing in the Amundsen Sea Polynya, Antarctica

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BACKGROUND:

- Polynyas are seasonally recurring areas of open water surrounded by sea ice. The Amundsen Sea Polynya (ASP) is on average the most productive in Antarctica per unit area[1,2] .
- Through grazing zooplankton form an important component of carbon export and food web dynamics with the ability to both retard and enhance carbon flux[3,4].
- The grazing impact of zooplankton within the ASP and causal mechanisms influencing zooplankton grazing were investigated using analysis of gut chlorophyll content from samples collected during the Amundsen Sea Polynya Research Expedition (ASPIRE).

METHODS:

- Samples from 6 day night paired MOCNESS tows in the ASP (Fig.1). 1/8th mesozooplankton split from each depth size fractioned to assess community grazing rates.
- Gut chlorophyll extracted using JGOFS protocol and measured on a Turner Trilogy Fluorometer.
- Grazing of the most dominant species from each depth at each station estimated using 3 replicates of 3-10 animals.
- Grazing rates calculated using methodology of Parsons et al 1986 and grazing impact calculated from depth integrated chlorophyll *a* standing stock of each station.
- Relationship between mesozooplankton gut contents and water column properties assessed using Generalised Additive Modelling (GAM) and Spearman's Rank (Rs) correlation in R.

Euphausia crystalorophias

Calanoidis acutus

Ostracod

Photo's courtesy of S. E. Wilson

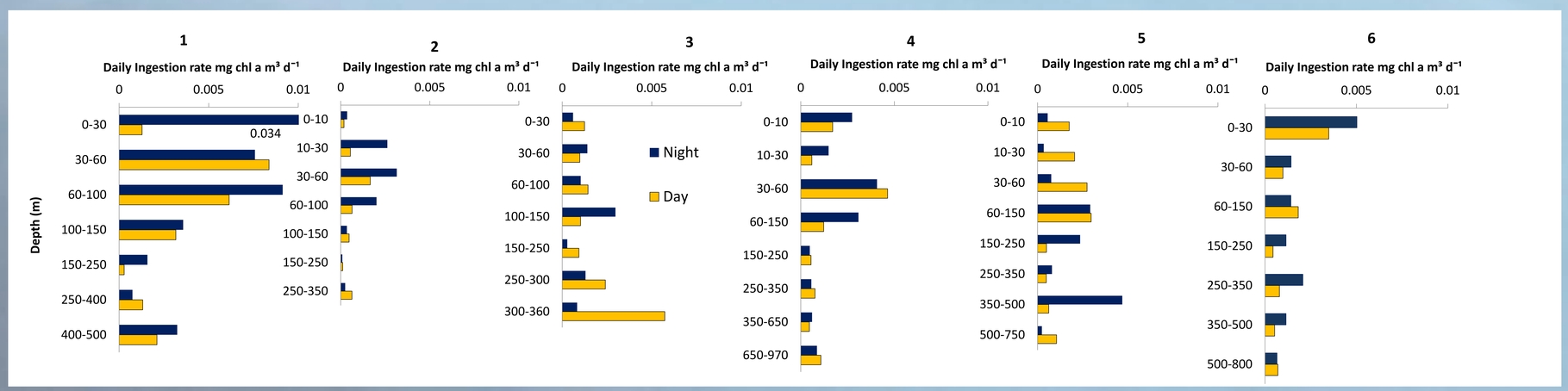

Fig.2 Mesozooplankton community grazing rates over depth from 5 stations within the polynya (1-5) and 1 station outside (6).

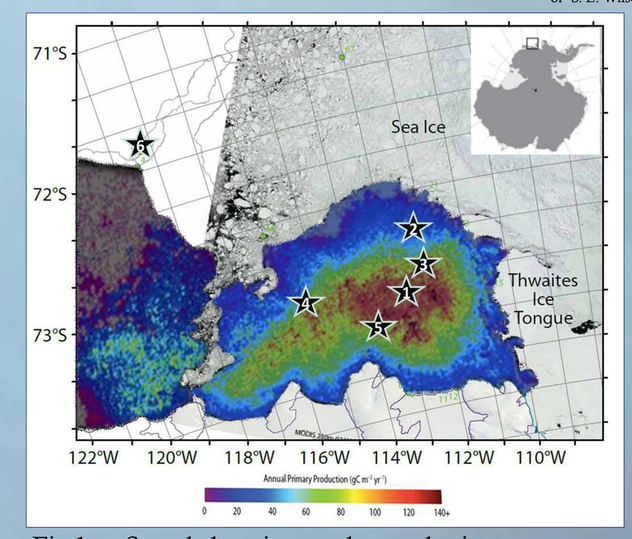

Fig.1 – Sample locations and annual primary production within the Amundsen Sea Polynya (adapted from Yager et al 2012).

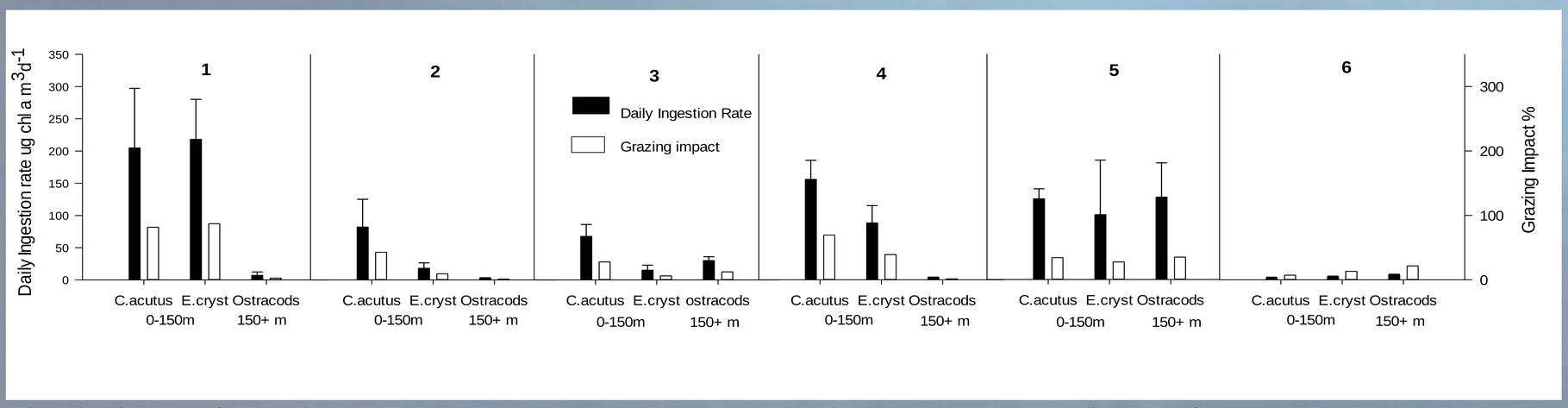

Fig.3 Grazing rates of *Calanoidis acutus, Euphausia crystalorophias* and Ostracods, and grazing impact upon chl *a* standing stock of the upper 150m.

DISCUSSION

- Greater mesozooplankton grazing in central polynya stations and some trend of higher grazing above 150m.
- *Calanoidis acutus* and *Euphausia crystalorophias* are the dominant grazers above 150m and can potentially consume up to 80% of chl *a* standing stock.
- Ostracods can be the most dominant grazers at depth, potentially consuming a large proportion of sinking phytodetritus.
- Mesozooplankton grazing exhibits a positive relationship with diatom standing stocks rather than *Phaoecystis antarctica,* the dominant phytoplankton within the ASP.
- Zooplankton may be unable to graze down the dominant phytoplankton effectively, exhibiting a functional response as standing stocks increase (Fig. 4 c)

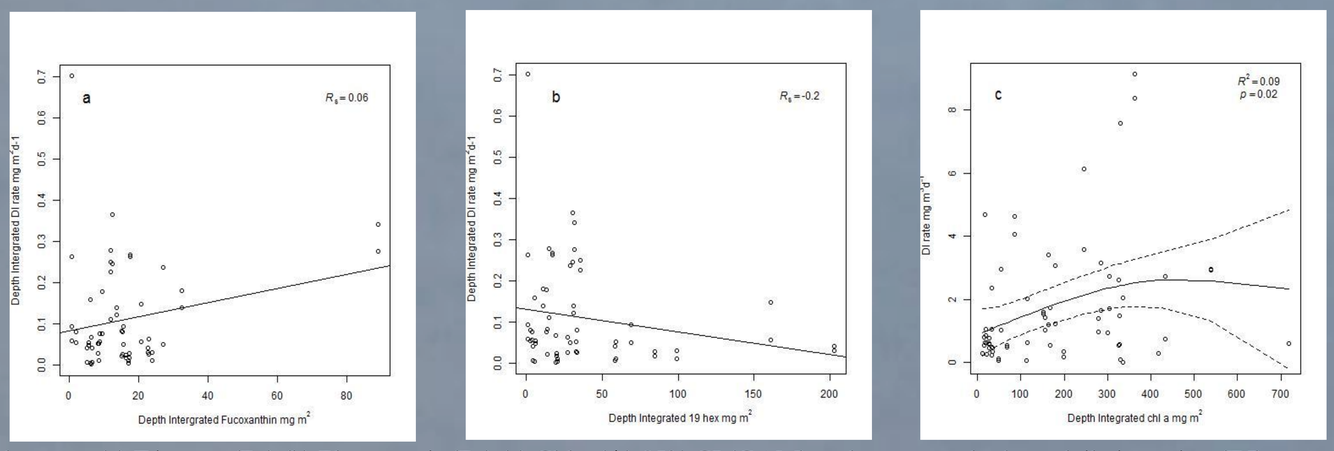

Fig.4 Relationship between (a) Diatoms (Rs) (b) Phaeocystis (Rs) (c) Chl *a* (±) 95% CI (GAM) and mesozooplankton daily ingestion (DI) rates within the ASP. (HPLC data courtesy of O. Schofield)

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References: (1) Yager : PL, Sherrell RM, Stammerjohn ACA, Schofield O, Abrahamsen EP, Arrigo KR, Bertilsson S, Garay DL, Guerrero R, Lowry KE, and others (2012) ASPIRE: The Amundsen Sea Polynya international research expedition. *Oceanography* 25(3):40–53, (2) Arrigo KR and van Dijken GL (2003) Phytoplankton dynamics within 37 Antarctic coastal polynya systems. *Journal of Geophysical Research*: *Oceans* (1978-2012): 108, (3) Steinberg DK, Buesseler KO, Van Mooy BAS, Boyd PW, Kobari T, Karl DM, (2008) Bacterial vs zooplankton control of sinking particle flux in the ocean's twilight zone. *Limnol. Oceanogr.* 53(4): 1327-1338, (4) Wilson SE and Steinberg DK (2010). Autotrophic picoplankton in mesozooplankton guts: evidence of aggregate feeding in the mesopelagic zone and export of small phytoplankton. *Marine Ecology progress Series.* 412:11-27.