Environmental controls on pteropod phenology along the Western Antarctic Peninsula

PATRICIA S. THIBODEAU1, DEBORAH K. STEINBERG1, COLLEEN E. MCBRIDE1, HUGH W. DUCKLOW2
1VIRGINIA INSTITUTE OF MARINE SCIENCE, COLLEGE OF WILLIAM AND MARY, GLOUCESTER POINT, VA
2LAMONT-DOHERTY EARTH OBSERVATORY, COLUMBIA UNIVERSITY, PALISADES, NY

OBJECTIVE

To determine if a shift in pteropod (pelagic snail), Limacina helicina antarctica, phenology (life history) has occurred due to warming or other environmental controls—change that would have important implications for regional food web dynamics.

INTRODUCTION

Limacina helicina antarctica is one of the most abundant zooplankton taxa in the Western Antarctic Peninsula (WAP), a region affected by rapid climate warming (Figure 1A) (Thibodeau et al. in review L&O). However, little is known about L. antarctica’s annually occurring life history events (phenology). L. antarctica is commonly found in sediment traps that are used to measure the rate of particle export, due to their sinking behavior to escape predators (Figure 1b) (Gilmer and Harbison, 1986).

METHODS

• Specimens were measured from the opening of the shell aperture directly across the diameter of the shell with CellSens image processing system (Figure 5).
• Up to 120 pteropod shells were measured from each cup.
• Data analysis done with R statistical software.

RESULTS

Size-frequency histograms were constructed to identify median shell size and time of appearance for each year of the time series. A new cohort of pteropods typically appears in May or June (austral fall to winter) and continues to grow throughout the winter season into the austral summer (Figure 6).

Median shell size for each cup of each year was determined to identify long-term trends in pteropod growth (Figure 7). Growth rates were determined by log-adding median shell sizes for each year of the time series and constructing linear models (Figure 8). There was no long-term, directional change in time of appearance or growth rate (Figure 9).

CONCLUSIONS

• Only study in Southern Ocean to illustrate pteropod shell growth during the ice-covered winter season.
• Strong interannual variability in the time of appearance of each new L. antarctica cohort (~90 days).
• Currently, no long-term pteropod phenology shifts in the WAP as indicated by time of appearance and growth rate.
• Most rapid growth occurs in November (austral summer) corresponding to a time of high biological productivity.
• Pteropod phenology may shift in the near future due to effects of warming, ice-free waters on cohort appearance and growth rate. These changes have unknown consequences for food web.

REFERENCES

Thibodeau, P. S., Steinberg, D. K., Hauri, C., Environmental controls on pteropod life history along the Western Antarctic Peninsula. Limnology Oceanography in review.

ACKNOWLEDGEMENTS

We are grateful to the crew of ARSV L. M. Gould, as well as Raytheon Solar Services, Lockheed Martin, and Leidos personnel for their support. We thank Joe Cape and Nena Keul for assistance with data collection and Stephanie Thanassekos for data analysis advice. This research was supported by the National Science Foundation Antarctic Organisms Ecosystems Program (OPP-0823101, PLR-1440435) and the Office of Academic and Studies at VIMS.