

RESEARCH ARTICLE

Ligament, hinge, and shell cross-sections of the Atlantic surfclam (*Spisula solidissima*): Promising marine environmental archives in NE North America

Pierre Poitevin^{1*}, Julien Thébault¹, Bernd R. Schöne², Aurélie Jolivet³, Pascal Lazure⁴, Laurent Chauvaud¹

1 Université de Bretagne Occidentale, Laboratoire des Sciences de l'Environnement Marin (UMR6539 UBO/CNRS/IRD/Ifremer), Plouzané, France, **2** Institute of Geosciences, University of Mainz, Johann-Joachim-Becher-Weg 21, Mainz, Germany, **3** TBM environnement/Somme, Technopole Brest-Iroise, Plouzané, France, **4** Ifremer, Laboratoire d'Océanographie Physique et Spatiale (UMR6523 CNRS/Ifremer/IRD/UBO), Plouzané, France

* poitevin.pierre@gmail.com



OPEN ACCESS

Citation: Poitevin P, Thébault J, Schöne BR, Jolivet A, Lazure P, Chauvaud L (2018) Ligament, hinge, and shell cross-sections of the Atlantic surfclam (*Spisula solidissima*): Promising marine environmental archives in NE North America. PLoS ONE 13(6): e0199212. <https://doi.org/10.1371/journal.pone.0199212>

Editor: Geerat J. Vermeij, University of California, UNITED STATES

Received: February 9, 2018

Accepted: June 4, 2018

Published: June 14, 2018

Copyright: © 2018 Poitevin et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Data Availability Statement: All data files are available from the Zenodo database (DOI: [10.5281/zenodo.1242929](https://doi.org/10.5281/zenodo.1242929), [10.5281/zenodo.1242892](https://doi.org/10.5281/zenodo.1242892), [10.5281/zenodo.1242821](https://doi.org/10.5281/zenodo.1242821)).

Funding: This work was supported by the EC2CO program MATISSE of the CNRS INSU, the Cluster of Excellence LabexMER, and the LIA BeBEST CNRS INEE. This research was carried out as part of the Ph.D. thesis of Pierre Poitevin for the University of Western Brittany with a French

Abstract

The Atlantic surfclam (*Spisula solidissima*) is a commercially important species in North American waters, undergoing biological and ecological shifts. These are attributed, in part, to environmental modifications in its habitat and driven by climate change. Investigation of shell growth patterns, trace elements, and isotopic compositions require an examination of growth lines and increments preserved in biogenic carbonates. However, growth pattern analysis of *S. solidissima* is challenging due to multiple disturbance lines caused by environmental stress, erosion in umbonal shell regions, and constraints related to sample size and preparation techniques. The present study proposes an alternative method for describing chronology. First, we analyzed growth patterns using growth lines within the shell and hinge. To validate the assumption of annual periodicity of growth line formation, we analyzed the oxygen isotope composition of the outer shell layer of two specimens (46°54'20"N; 56°18'58"W). Maximum $\delta^{18}\text{O}_{\text{shell}}$ values occurred at the exact same location as internal growth lines in both specimens, confirming that they are formed annually and that growth ceases during winter. Next, we used growth increment width data to build a standardized growth index (SGI) time-series (25-year chronology) for each of the three parts of the shell. Highly significant correlations were found between the three SGI chronologies ($p < 0.001$; $0.55 < \tau < 0.68$) of all specimens. Thus, ligament growth lines provide a new method of determining ontogenetic age and growth rate in *S. solidissima*. In a biogeographic approach, the shell growth performance of *S. solidissima* in Saint-Pierre and Miquelon was compared to those in other populations along its distribution range in order to place this population in a temporal and regional context.