Akihiko SUZUKI[1]：Periwinkle dominated death assemblage washed up on Passage Beach, Saint John, eastern Canada

鈴木明彦[1]：カナダ東部，セントジョン，パッセージビーチのタマキビ優占遺骸群集

Introduction Modern rocky shores consisting of boulder beaches in the intertidal zone are well studied from an ecological viewpoint（Raffaelli and Hawkins 1996）. However, rocky shores and their associated biotas are rare in the fossil record due to the high-energy conditions of environments and the erosion associated with changes in sea-level（Sørensen and Surlyk 2015）. Comparative studies of modern life and the death assemblages associated with rocky shores are useful for elucidating the species composition and diversity of fossil assemblages（Schopf 1978; Suzuki and Ito 2002）.

This study was undertaken to examine the occurrence of stranding of shells on a boulder beach near Saint John in eastern Canada in 2014, and to perform a faunal analysis of the molluscan death assemblage along the shoreline. Of the sites examined, Passage Beach to the south of Saint John was considered to be a typical boulder beach with numerous stranded shells. The relationship between the species composition of the molluscan death assemblage and the characteristics of the shore environment were also considered.

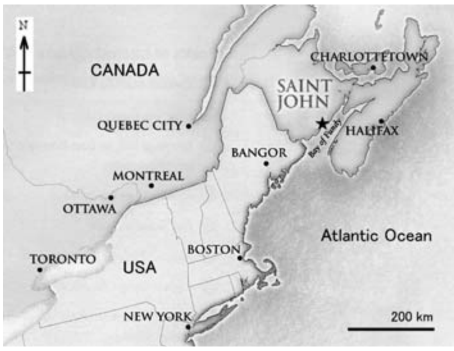

Fig.1 Map showing the study site in Saint John, Canada. The collection site is indicated by a star.

Materials and Methods The Saint John area in New Brunswick in eastern Canada is a well-known Global Geopark that faces the Bay of Fundy, which has one of the highest high-tide areas in the world（Miller 2014）.

The study site, Passage Beach, was located on the southern Saint John coast in New Brunswick, eastern Canada（Fig. 1）. The site consisted of a boulder beach connected to a pier（Fig. 2A）. Mollusk shells were collected on the beach during ebb tide on 20 September 2014（Fig. 2B）, and washed-up shells associated with other marine organisms were also recorded.

The collected mollusks were identified based on published taxonomic literature（Tucker and Morris 1995; Cornall and Simard 2014）, and ecological characteristics such as substrate and habitat preference were inferred based on previous studies（Gardner and Thomas 1987; Sharp 1998）.

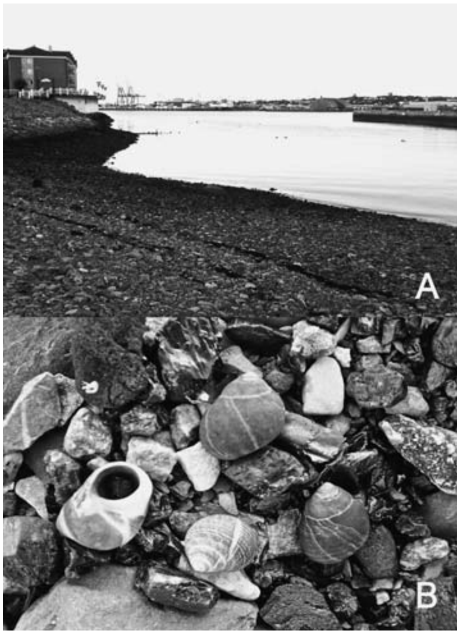

Fig.2 Photograph of Passage Beach, Saint John. A. View of the beach in late September 2014. B. Periwinkle shells washed up on the beach.

Results The death assemblage consisted of three species belonging to two genera in two families（Table 1）. The most abundant species were the common periwinkle, *Littorina littorea*, which accounted for approximately 96％ of the species observed. Other gastropod species observed were the rough periwinkle, *L. saxatilis* and Stimpson's whelk, *Colus stimpsoni*.

Littorina littorea was distributed in patches near the strand line on the beach. The shell surface and color patterns for this species were generally well preserved, and few abraded shells were observed. In contrast, *L. saxatilis* and *C. stimpsoni* were rarely observed on the beach, and these species are poorly preserved due to abrasion and dissolution. *L. saxatilis*, *C. stimpsoni* and *L. littorea* have also been associated with the knotted wrack, *Ascophyllum nodosum*, a brown

Table 1 List of drifted shells collected in Passage Beach, Saint John.

Specific name	Substrate	Habitat	Indivudual number
（Gastropoda）			
Littorina littorea	Rock	Lower Intertidal	110
L. saxatilis	Rock	Upper Intertidal	2
Colus stimpsoni	Rock	Subtidal	2

seaweed found in the lower intertidal zone（Cornall and Simard 2014）.

Discussion Table 1 shows the relative proportion of habitat types associated with the molluscan death assemblage in the study site. Lower intertidal species, such as *L. littorea*, were generally more abundant in the death assemblage than other species. *Littorina littorea* is a relatively large littonid（Sharp 1998）, with a robust shell capable of resisting considerable physical disturbance in comparison with other rocky shore gastropods（Schopf 1978）.

Lower intertidal species were typically well represented in the death assemblage because boulder beaches often have well defined sedimentation areas due to rapid changes in the hydrological conditions along a beach profile（Kaszuba 1990）. The absence of bivalves on boulder beaches could be related to such beaches being located at or near the high-tide mark which would increase exposure to air（Miller 2014）, and because boulder beaches are characterized by pronounced abrasion and/or substrate movement（Schopf 1978; Kaszuba 1990）. In conclusion, mollusks with robust shells（e.g. large periwinkle）are more likely to be preserved in the fossil record under the high-energy conditions of rocky shore environments, while fragile shells and seaweeds are poorly preserved.

As intertidal rocky shore environments are subjected to extensive disturbance and erosion, evaluating species composition and diversity in high-energy environments is considered to be important in an ecological context（Schopf 1978; Kaszuba 1990）. Although beachcombing shells that have washed up on the shore is considered to be a novel method for conducting taphonomic surveys, clarifying the relationship between death assemblages that have been washed up on the shore and extant assemblages in high-energy environments is considered necessary to understand the ecology of the species in these environments（Suzuki and Ito 2002; Sørensen and Surlyk 2015）.

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要約：2014年９月下旬，カナダ，セントジョン，パッセージビーチにおいて，ビーチコーミングにより貝類遺骸を採集した．貝類遺骸群集は，巻貝３種のみから構成され，タマキビ類が卓越していた．下部潮間帯種のヨーロッパタマキビが優占し，上部潮間帯，潮下帯の種はわずかであった．これは，大型で堅固なタマキビは、高エネルギー環境下の潮間帯でも、化石として保存される可能性があることを示している．

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