A Record of Hart’s-Tongue Fern（Asplenium scolopendrium L.） Inhabiting Holes in Concrete Armor Blocks on the Coast of Southern Hokkaido, Japan

A Record of Hart's-Tongue Fern (*Asplenium scolopendrium* L.) Inhabiting Holes in Concrete Armor Blocks on the Coast of Southern Hokkaido, Japan

MURAKAMI Kentaro

Laboratory of Landscape Ecology, Regional Environmental Science Group, Hakodate Campus,
Hokkaido University of Education, Hakodate 040-8567

道南地域の海岸消波ブロックの穴に生育している コタニワタリ（*Asplenium scolopendrium* L.）の記録

村　上　健太郎

北海道教育大学函館校　地域環境科学グループ　景観生態学研究室

ABSTRACT

Hart's-tongue fern (*Asplenium scolopendrium* L.), a species usually found in mountain forests, was recorded in the bottom of holes in armor blocks on a coastal sandy beach of southern Hokkaido, Japan. The location was Omonai, Shiriuchi-cho, Kamiiso-gun, Hokkaido, where many concrete blocks with vertical holes have been lined up in 10 rows. The largest number of individuals was identified on the land side row. Four other ferns (*Athyrium sinense*, *Dryopteris crassirhizoma*, *Equisetum arvense*, and *Polystichum retrosopaleaceum*) were also identified in the same type of holes at this site. *Asplenium scolopendrium*, *Athyrium sinense*, *D. crassirhizoma*, and *P. retrosopaleaceum* are forest floor ferns. The depth of the holes where these ferns grew was approximately 60 cm, and the cross-sectional area of the holes was approximately 60 cm×18 cm. Typically, only shade-intolerant species, such as ruderals or coastal grass species, can grow on sandy beaches, and immigration of forest floor ferns is difficult. However, the holes in the blocks created rock-shade-like environments and formed a microhabitat for these species. Installation of such concrete blocks could be useful for the conservation of *A. scolopendrium* in areas where this species is endangered.

Introduction

Hart's-tongue fern (*Asplenium scolopendrium* L.) is a species widely distributed from North America

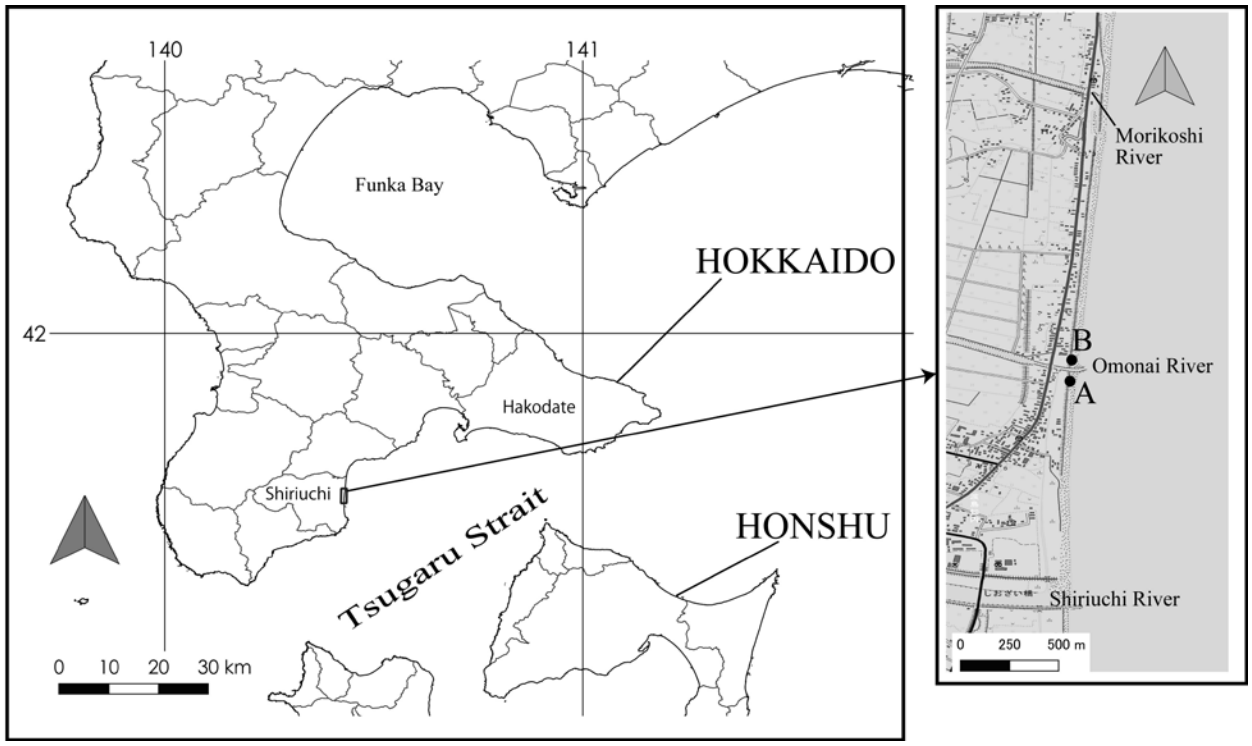

Figure 1. Study sites A and B; individuals of *A. scolopendrium* were found at site A only; A part of this map was created based on the Topographic Map of Japan, 1/25,000 scale of the Geospatial Information Authority of Japan

to Eurasia (Asano and Kuwahara, 1990; Iwatsuki, 1992). In Japan, it is distributed over a wide range from Hokkaido to Kyushu, with a bias toward the Sea of Japan (Iwatsuki, 1992). In Hokkaido, it is found over a wide range, except in the Pacific side of eastern Hokkaido (Umezawa, 2015), and it is not a rare species. There are several records from southern Hokkaido around Hakodate City, including Mount Hakodate (Sugawara and Komatsu, 1959). The original habitat of *A. scolopendrium* is the somewhat dark and moist mountainous forest floor (Iwatsuki, 1992). The present author recorded *A. scolopendrium* in the coastal area in an unusual setting during a survey of coastal plants.

Materials and Methods

When investigating coastal plants in October 2017, the author discovered *A. scolopendrium* at a site where coastal wave-dissipating armor blocks had been constructed in Omonai, Shiriuchi-cho, Kamiiso-gun, Hokkaido (Figure1, site A). The author visited the site again in June 2018 and recorded the growth and other vegetation conditions. Using Google Maps aerial photographs, the author determined in advance where there were blocks of the same type as those found at site A of Figure 1 and visited the area of the coast where such blocks were found (Figure 1, site B). All ferns, including *A. scolopendrium,* were assessed for growth in the holes in the blocks. In June 2019, a survey was conducted to see if there were any changes in the conditions identified in 2018.

The coast of Shiriuchi-cho facing the Tsugaru Strait has more than 10 km of sandy and shingle beaches, and Google Maps aerial photographs show that many sections have armor blocks. The present report was not obtained by walking all along the coast in this area but is a preliminary result of only two

local observations and a simple vegetation survey. According to the mesh climatic value (average value from 1980 to 2010) (National Land Information Division, National Spatial Planning and Regional Policy Bureau, Government of Japan, 2011), the average annual temperature in this area is 9.1° C, the annual precipitation is 1,261.5 mm, and the greatest snow depth is 40 cm.

Results

At site A (Figure 1), 10 individuals (2017) and 14 individuals (2018 and 2019) of *A. scolopendrium* were identified (Photo 1). On this coast, 10 rows of terraced wave-dissipating concrete blocks had been installed between the sandy beach and the promenade behind the beach (Photo 2). Each concrete block has a diamond-shaped hole (with cross-sectional area ca. 60×18 cm) in the vertical direction. Because there is a dent in the connecting part with the adjacent block, this part also forms a vertical hole with the adjacent block (Photos 1 and 2). The holes closer to the sea side were buried in sand, but those closer to the land side (promenade side) had depths of several tens of centimeters. *A. scolopendrium* was found in 9 of the 60 holes (15.0%) in the blocks in the closest row to the promenade. *A. scolopendrium* was also found in one hole in each of the second, third, and fourth rows from the promenade side. Thus, a total of 12 holes were identified as microhabitats of *A. scolopendrium* at site A. Not only *A. scolopendrium,* but also one or two individuals of *Athyrium sinense*, *D. crassirhizoma*, and *P. retrosopaleaceum*, were found in the nearest row to the promenade. *E. arvense* was found in six holes, regardless of row location. Thus, a total of five fern species, including *E. arvense,* were recorded in this study.

The holes varied in depth (depending on the volume of sand) and the vegetation present. Holes where

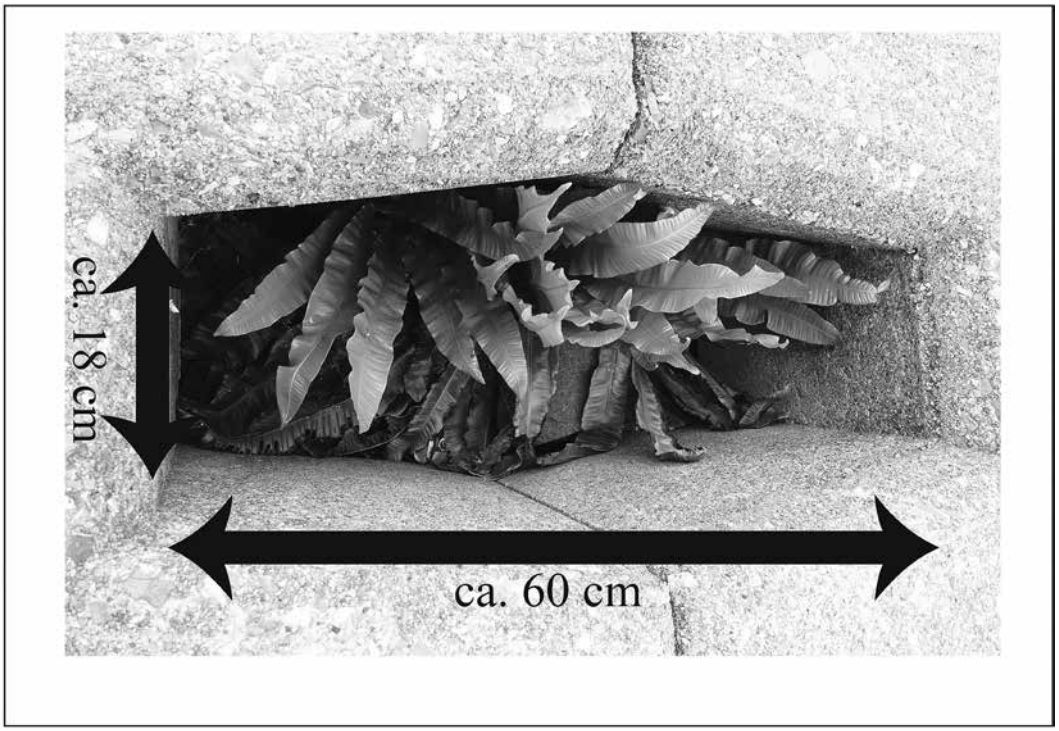

Photo 1. Hole in concrete armor blocks inhabited by *A. scolopendrium*

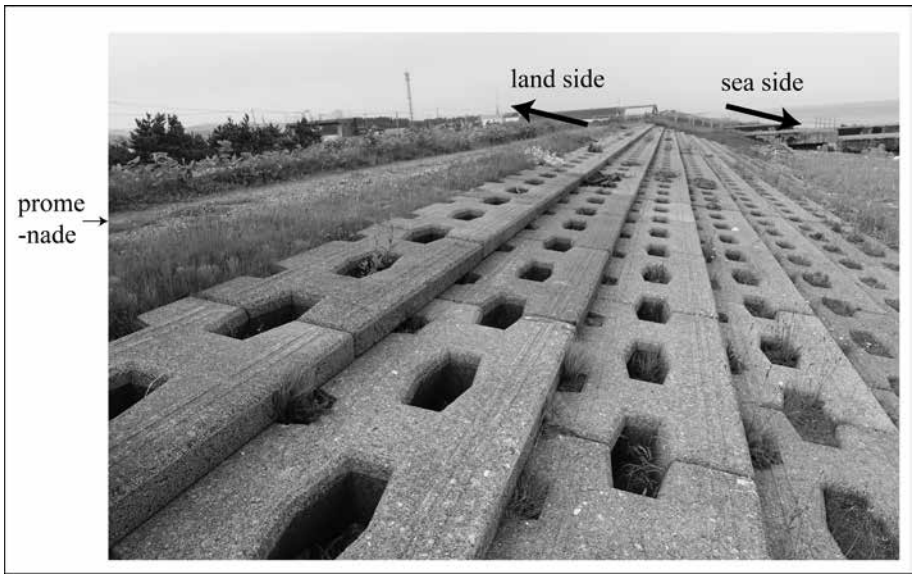

Photo 2. Stepped armor blocks and their holes at site A

Photo 3. Stepped armor blocks and their holes at site B

any of the four fern species, except *E. arvense,* were growing were at approximately 60 cm deep. In deeper holes (more than about 50 cm), the common species other than ferns were *Ampelopsis glandulosa* var. *heterophylla*, *Celastrus orbiculatus*, *Cirsium vulgare*, *Dactylis glomerata*, *Hypochaeris radicata*, *Plantago lanceolate* and *Toxicodendron orientale*. Many of the holes near the sandy beach were covered with sand, and in addition to alien species such as *H. radicata* and *P. lanceolata*, sandy coastal plants such as *Arabis stelleri* var. *japonica*, *Artemisia stelleriana*, *Calystegia soldanella* and *Lathyrus japonicus* were observed. However, site B (Figure 1 and Photo 3) also had many concrete armor blocks with holes similar to those at site A, but no fern species were found at site B.

Discussion

There are a few known coastal ferns growing in Japan, such as Japanese Holly Fern (*Cyrtomium*

falcatum) or *Sphenomeris biflora* (Iwatsuki, 1992). However, except for *E. arvense*, the ferns recorded in this study are not coastal plants, but are essentially forest floor species. It is interesting that these species' habitats were found in the holes of concrete blocks. Although the sandy beach has almost no canopy and is almost completely occupied by shade-intolerant plant species, such as ruderals and coastal grass plants, these artificial small spaces created microhabitats for forest ferns. It is presumed that the shady rock-like environment created by these holes made it possible to form the fern gametophyte, called the prothallium, which is important for fern growth. The habitat types of *A. scolopendrium* have been described as shady forest floor (Iwatsuki, 1992; Otsuka, 2004) and mossy rocks in the mountains (Knapp, 2011), but in Europe walls of buildings are noted as secondary habitats (Bremer and Jongejans, 2010; Edgington, 2007; Rishbeth, 1948; Payne, 1978; Tamas *et al.*, 2017). More specific habitat types, such as north-facing walls or walls near a vertical rainfall drainage pipe (Tamas *et al.*, 2017) or track bed gravel in the train station (Wittig, 2002), have also been described. The track bed gravels reported by Wittig (2002) may be similar to the situation reported in this study. *A. scolopendrium* has been found to grow in many places in the London metropolitan area (Edgington, 2007). There is a record of *A. scolopendrium* growing in a roadside hardscape habitat even in Japan (Murakami, 2019). This species is inherently suited to forest floors, cliffs, and rocks, but it may also be tolerant of artificial hardscape environments, such as urban walls.

A. scolopendrium is not an endangered species at the national level in Japan, but in some prefectures on the Pacific side of southwestern Japan (*e. g.*, Chiba, Kanagawa, Aichi, and Wakayama) and the northern part of Kyushu (*e. g.*, Fukuoka, Oita, Saga, and Kumamoto) in the warm temperate zone, it is listed as an endangered species in the red data books for each prefecture (Association of Wildlife Research and EnVision, 2019). It has also been recorded as extinct (Matsuyama City, 2012). These areas are presumed to be close to the climatic limits for this species. In such areas, the fact that *A. scolopendrium* grows on walls and in holes and gaps among concrete blocks, as reported in this study, may be useful for conservation of populations of this species. For example, it may be possible to create new habitats by installing concrete blocks with holes near the remaining individuals or on the forest floor where this species has grown in the past. On the other hand, no ferns were recorded at site B, although it seemed to have similar conditions to site A. Therefore, if the same types of concrete blocks are installed on the coast, it cannot be assumed that a habitat for ferns has been created. There will be room for further research on what environmental conditions are suitable for this species.

Conclusion

This study described the records of ferns growing in the holes of civil engineering structures on the seacoast and discussed how to use them as microhabitats. These structures were created for the purpose of wave dissipation and hydrophilicity and were not intended for the introduction of terrestrial plants. However, as a result, they created fern habitats. Such artificial hard structures may be used for conservation of various species and for improvement of biodiversity.

Acknowledgments

Some technical terms used in this report were received advices by Kohei Oka (Hiroshima Institute of Technology) and Yuzo Kusunose (Ecosystem Research). This work was supported by JSPS KAKENHI Grant Number JP19K06104.

REFERENCES

Asano, S. and Kuwahara, Y. (1990) The Ecological Encyclopedia of Wild Plants in Japan. Zenkoku Noson Kyoiku Kyokai, 664pp. Tokyo (in Japanese)

Association of Wildlife Research and EnVision (2019) Search system of Japanese Red Data. http://www.jpnrdb.com/index.html. Accessed 18 September 2019 (in Japanese)

Bremer, P. and Jongejans, E. (2010) Forest and forest stand effects on the population dynamics of *Asplenium scolopendrium*. Population Ecology, 52(1): 211–222.

Edgington, J. A. (2007) Dynamics of long-dispersal: The spread of *Asplenium adiantum-nigrum* and *Asplenium trichomanes* (Aspleniaceae: Pteridophyta) on London walls. Fern Gazette, 18(1): 31–38.

Iwatsuki, K. (1992) Wild Plants of Japan, Ferns and Fern Allies. Heibon-sha, 311pp. Tokyo (in Japanese)

Knapp, R. (2011) Ferns and Fern Allies in Taiwan. Yuan-Liou Publishing, Taipei

Matsuyama City (2012) Red Data Book of Matsuyama City 2012. http://www.city.matsuyama.ehime.jp/shisei/hozen/red/group9/ Accessed 18 September 2019 (in Japanese)

Murakami, K. (2019) Urban and suburban hardscapes as habitats for ferns: discussion from a data set of Chubu region, Japan. Journal of the Japanese Society of Revegetation Technology, 45(2): 299–307. (in Japanese with English abstract)

National Land Information Division, National Spatial Planning and Regional Policy Bureau, Government of Japan (2011) Climatic Data Mesh. http://nlftp.mlit.go.jp/ksj/. Accessed 17 September 2019 (in Japanese)

Otsuka, K. (2004) Ferns and Fern Allies of Shinshu, Japan. Hoozuki Shoseki, 194pp. Nagano (in Japanese)

Payne, R. M. (1978) The flora of walls in south-eastern Essex. Watsonia, 12: 41–46.

Rishbeth, J. (1948) The flora of Cambridge walls. Journal of Ecology, 36: 136–148.

Sugawara, S. and Komatsu, T. (1959) Hakodate-yama Shokubutsu-shi (Flora of Mount Hakodate) . Hakodate City Library, 233pp. Hakodate (in Japanese)

Tamas, J., Vida, G., Csontos, P. (2017) Contributions to the fern flora of Hungary with special attention to built walls. Botanikai Közlemények, 104(2): 235–250.

Umezawa, S. (2015) Hokkaido no Shida Nyumon Zukan (Illustrated Book for Introduction to Ferns in Hokkaido). Hokkaido University Press, 145pp. Sapporo (in Japanese)

Wittig, R. (2002) Ferns in a new role as a frequent constituent of railway flora in Central Europe. Flora, 197: 341–350.

(函館校准教授)