Evaluating the current status of the zonation of coastal dune vegetation in the Boso Peninsula using UAS-SfM photogrammetry

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The landward sides of coastal dunes have been modified by the creation of farmlands and erosion control forests, as well as the construction of harbors, airports, roads, and residential areas. On the sea side of coastal dunes, structures including revetments and detached breakwaters have been installed to prevent coastal erosion. Consequently, the total area of coastal dunes in Japan has significantly decreased, and the ecosystem therein has been greatly affected by these changes. The number of endangered species per unit area in coastal dunes is particularly larger than that for forests and wetlands. Therefore the conservation and restoration of coastal dunes and their ecosystem are required. Although coastal dunes partially remain in Japan, most of their natural environment is not well preserved. Under the natural condition, each plant grows in its preferred environment, and coastal dunes have the vegetation structure called a zonation under natural environment. This structure is an effective indicator of ecosystems. After the Great East Japan earthquake, the establishment and extension of coastal levees have progressed in many areas, and the zonation of coastal dune vegetation that sparsely remained has been disappearing. Therefore, it is necessary to quickly evaluate the current status of the vegetation zonation using a relatively simple method for environmental conservation and restoration. We investigated the spatial relationships between vegetation and landforms using high-resolution ground surface information obtained from unmanned aerial system-based structure-from-motion (UAS-SfM) photogrammetry. These high resolution images made it easy to create a vegetation map. Sand dune vegetation was classified into several communities, and a vegetation map was created based on the orthorectified images obtained by UAS-SfM photogrammetry. We analyzed the correlation between vegetation and landforms to evaluate the current status of the zonation of coastal dune vegetation. The zonation tended to be dominated by *Calystegia soldanella* and *Zoysia macrostachya* communities in front of the coastal dune; *Carex kobomugi* , *Melanthera prostrata* and *Ischaemum anthephoroides* communities in the middle; and *Oenothera laciniata* and Imperata cylindrica communities at the back. Since *Calystegia soldanella* is a pioneer species, it can grow in front of a coastal dune prone to disturbance by waves. Since there are many sand movements in the middle of a coastal dune, species that prefer sedimentary environment are dominant. Since the area behind a sand dunes is stable, *Oenothera laciniata* and *Imperata cylindrica* occur.

Keywords: Zonation, Coastal dune vegetation, Landforms, UAS-SfM photogrammetry

