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RESEARCH

Host plant diversity and potential habitat prediction of *Korthalsella japonica* (Thunb.) Engl. in Jeju Island, South Korea

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Background: Parasitic mistletoes infect a wide range of host plants, and when infestation density is high, they alter host resource allocation and canopy structure, thereby affecting ecosystem components including light regimes and understory vegetation. In South Korea, research has primarily focused on their bioactive properties, with limited attention to host associations or ecological traits. This study examined the host plant diversity and preference of *Korthalsella japonica* (Thunb.) Engl. and predicted its potential habitats to provide baseline data for conservation planning.

Results: *Korthalsella japonica* was found on 26 host species belonging to 11 families and 18 genera, including 15 newly recorded host plants. A clear preference for warm-temperate evergreen broad-leaved trees was observed, particularly *Eurya japonica* Thunb. and *Camellia japonica* L. This pattern indicates that host selection is shaped not only by parasitic opportunism but also by physiological compatibility and the spatial structure of densely distributed evergreen assemblages. Predicted suitable habitats were primarily concentrated in gently sloping areas near streams within the lower mid-mountainous regions of Jeju Island, aligning well with actual vegetation structures and host plant distributions.

Conclusions: The distribution of *K. japonica* reflects an intermediate level of host specificity, closely associated with warm-temperate evergreen broad-leaved forests. These findings advance understanding of the ecology of *K. japonica* by revealing its host diversity, habitat preferences, and key environmental determinants, and they provide valuable baseline data to guide future conservation planning and management strategies.

Keywords: habitat suitability, hemiparasitic plant, host–parasite interaction, MaxEnt modeling, warm-temperate vegetation

Introduction

In South Korea, five mistletoe taxa belonging to two families and four genera are distributed: *Viscum album* L. var. *lutescens* Makino, *Viscum album* L. f. *rubroauranticum* (Makino) Kitag., and *Korthalsella japonica* (Thunb.) Engl. of the Santalaceae, as well as *Loranthus tanakae* Franch. & Sav. and *Taxillus yadoriki* (Siebold ex Maxim.) Danser of the Loranthaceae (Kim et al. 2013; Lee and Kang 2011). Mistletoes are hemiparasitic plants that perform photosynthesis while absorbing water and mineral nutrients from their hosts, typically parasitizing branches, twigs, and sometimes roots (Kim et al. 2013). Their survival depends on close ecological interactions with their host plants.

Mistletoes penetrate host tissues through haustoria to extract water and nutrients, often imposing mechanical, chemical, and physiological stresses on their hosts (Lee 2009). However, some studies have reported that mistletoes provide essential resources such as food and shelter for various birds, mammals, and insects, contributing to vegetation diversity and functioning as keystone resources within ecosystems (Watson 2009). Thus, while mistletoes impose physiological and structural burdens on individual hosts, they simultaneously play important ecological roles at the community level.

Understanding the ecological traits and habitat preferences of parasitic plants provides not only basic biological information but also insights into the evolutionary background and adaptive mechanisms of parasitism (Suetsugu et al. 2008). The distribution of parasitic plants is strongly dependent on the presence and spatial distribution of host species (Watson 2001) and is closely linked to regional topography, vegetation structure, and environmental changes (Yang et al. 2020). Because parasitic plants exhibit strong host dependence, climate change can indirectly affect their distribution through host range shifts, drought-induced water stress, and phenological mismatches, as well as directly through altered temperature and moisture regimes. Accordingly, understanding host-linked ecology provides a basis for prioritizing and guiding conservation and management strategies for both host and parasitic species under changing environmental conditions (Renjana et al. 2022).

Among native Korean mistletoes, *K. japonica* is mainly distributed in Jeju Island and southern coastal regions, exhibiting a limited geographic range. This restricted range likely reflects strong host dependence and sensitivity to mesic microclimates, implying high reliance on particular evergreen hosts and habitat conditions (Skrypnik et al. 2020; Watson 2001). However, existing domestic studies on *K. japonica* have focused primarily on bioactive properties such as antioxidant, anticancer, and immunomodulatory effects (Kwon et al. 2012; Park and Kim 2017), with limited research on host associations, parasitic patterns, and habitat distribution. This knowledge gap hinders a comprehensive understanding of the species' survival strategies, host dependency, and environmental adaptations, thereby limiting the development of effective conservation and climate response strategies.

This study aims to (1) analyze the diversity and host preferences of *K. japonica* and (2) predict its potential habitat distribution based on environmental variables. In doing so, we examine which host taxa predominantly support parasitism and the resulting host-preference pattern, identify the environmental predictors that best explain landscape-scale suitability within a MaxEnt framework, and evaluate how well a conservative binary threshold (10th-percentile training presence) captures current occurrences. Through this approach, we seek to provide a comprehensive understanding of the ecological characteristics of *K. japonica* and generate baseline data for future conservation and management strategies.

Materials and Methods

Target species and study area

Korthalsella japonica is an evergreen dwarf shrub belonging to the family Santalaceae. In the Korean Peninsula, it is distributed mainly on Jeju Island and in the coastal islands of Gyeongsangnam-do and Jeollanam-do, while its broader range extends across subtropical to tropical regions, including China, Japan, Taiwan, Southeast Asia, and Australia (Kim and Kim 2018). The individuals observed in this study in Jeju Island ranged in size from approximately 1–15 cm in height and 0.4–20 cm in width (Fig. 1).

The study area was Jeju Special Self-Governing Province, South Korea, which covers approximately 1,826 km^2 and is located at approximately 33°06′–34°00′ N and 126°08′–126°58′ E (Hong et al. 2019) (Fig. 2). Mount Hallasan, with an elevation of 1,950 m, is located at the center of the island. According to the Köppen climate classification, Jeju Island falls within the humid subtropical climate zone (Cfa), where vegetation exhibits a distinct vertical structure, supporting tropical and subtropical flora at lower elevations and temperate to subalpine species at higher elevations (Choi et al. 2023; Park et al. 2019).

Host plant survey and diversity analysis

To assess the host plant diversity of *K. japonica*, field surveys, literature reviews, and specimen examinations were conducted. From March to June 2025, field surveys were conducted at eight sites, including the Warm Temperate and Subtropical Forest Research Center (WTSFRC), Halla Arboretum, Jeju National University, Seondol, Gosalli Forest, Hyodoncheon (Molgorangso), Hyodoncheon, and Seo-

Fig. 1 Host plants and *Korthalsella japonica* (left: *Camellia japonica* L.; right: *Eurya emarginata* (Thunb.) Makino).

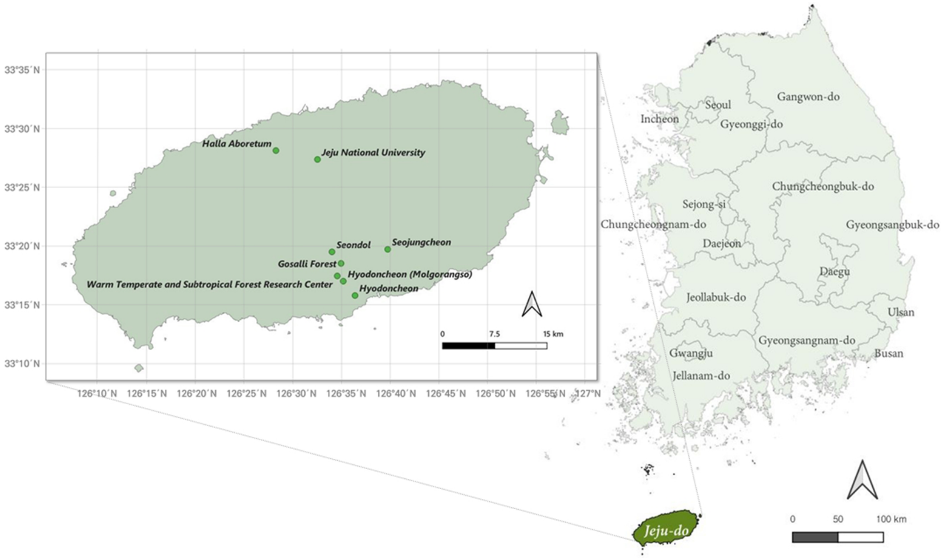


Fig. 2 Study site and field survey locations.

Fig. 3 Habitat environments of *Korthalsella japonica* (left: Seojungcheon; right: Gosalli Forest).

jungcheon (Figs. 2 and 3). The survey sites were selected based on the location information of existing herbarium specimens and expert consultation, and field visits were conducted to verify the occurrence of *K. japonica*. To obtain data for host preference analysis, the occurrence of *K. japonica* was surveyed within areas generally extending up to 1 km from each occurrence point, with the actual range adjusted depending on site characteristics such as topography and vegetation. Each site was treated as an independent replicate, and trees within these areas were examined for parasitism. A total of 98 parasitized host trees were recorded. This area-based sampling design ensured appropriate spatial coverage and representativeness for analyzing host diversity and preference.

At each site, host individuals parasitized by *K. japonica* were recorded, including host species name, tree height, diameter at breast height, and the number of *K. japonica* individuals. In addition, environmental characteristics of each site were documented to comprehensively examine host distribution and parasitic patterns.

Previously reported host species were compiled through a literature review and combined with the field survey data to construct an updated host list. Furthermore, specimens stored in the herbarium of the WFRC were re-examined and incorporated into an updated host inventory. Specimens of *K. japonica* and their respective hosts collected during field surveys were prepared as voucher specimens, which are deposited at the WFRC herbarium of the National Institute of Forest Science (Table S1).

The identified host plants were classified at the family, genus, and species levels, and their growth forms were categorized based on leaf phenology (evergreen or deciduous) and leaf type (broad-leaved or coniferous). Based on these classifications, the species composition and growth characteristics of the host plants were summarized, and the host preferences of *K. japonica* were analyzed. In addition, the number of host individuals recorded in the field was used to identify major host groups and plant species with high parasitism frequencies.

To quantitatively assess host diversity and evenness, the Shannon diversity index (H′) and Pielou's evenness index (J′) were calculated (Norton and De Lange 1999; Solikin 2022). The Shannon index was computed based on the relative proportion of each host species, and the evenness index was derived by standardizing the observed Shannon index against its theoretical maximum value. Furthermore, to evaluate whether the distribution of parasitism among host species differed significantly from a uniform pattern, a Chi-square goodness-of-fit test was conducted.

Potential habitat distribution modeling

The potential habitat of *K. japonica* was predicted using MaxEnt version 3.4.4, a machine-learning algorithm that estimates habitat suitability based on the relationship between species occurrences and environmental variables (Elith et al. 2011; Phillips et al. 2006). Nine environmental variables were initially considered, including six continuous variables (elevation, slope, aspect, Normalized Difference Vegetation Index [NDVI], distance from streams, and Topographic Wetness Index) and three categorical variables (land cover, forest type, and forest type of physiognomy) (Table 1). Topography reflects energy–water gradients that shape the spatial structure of evergreen broad-leaved stands, and NDVI serves as a stand-scale proxy for host availability and canopy condition. Hydrological predictors reveal mesic microclimatic properties associated with water supply and accumulation, while the forest context characterizes stand composition and structure, presenting environmental conditions related to host occurrence and branch architecture. Pairwise Pearson correlation analysis was applied only to continuous variables to detect multicollinearity, and when two predictors were highly correlated ($|r| \geq 0.8$), the variable with lower ecological relevance was excluded. Categorical predictors were not included in the correlation analysis but were evaluated separately based on model performance (area under the ROC curve [AUC]) and ecological relevance. Based on these assessments, five continuous variables—elevation, slope, aspect, NDVI, and distance from streams—were selected for the final MaxEnt model.

All environmental raster layers were standardized in terms of spatial extent, coordinate system (EPSG:5179, Korea 2000 / Central Belt), and 250 m spatial resolution using the nearest-neighbor resampling method in QGIS 3.40.3 to ensure spatial consistency. Preliminary analyses using finer spatial resolutions (30–100 m) did not improve model performance and instead increased spatial noise and reduced stability due to local terrain variation and data inconsistency. Therefore, the 250 m resolution was determined to be the optimal spatial scale, effectively capturing the landscape-level distribution of *K. japonica* while providing stable AUC values. Statistical standardization was not applied, as MaxEnt internally normalizes continuous predictors during model training.

For binary habitat classification, the 10th percentile training presence threshold was applied, which is widely used to minimize commission errors while retaining ecologically meaningful predicted areas.

Occurrence data were compiled from field surveys and supplemented with additional records from literature sources. To reduce spatial sampling bias and prevent model overfitting, duplicate records within the same 250 m grid cell were removed, resulting in a final dataset of 27 high-confidence occurrence points from an initial 121 records. Model training and evaluation were conducted using 10 bootstrap replicates, with 75% of the data randomly used for training and 25% for testing in each iteration. Model performance was evaluated using the AUC, and binary habitat classification followed the 10th percentile training presence threshold, a standard criterion that minimizes commission errors while retaining ecologically meaningful predicted areas. Variable contribution analysis was performed to identify the key environmental factors influencing the distribution of *K. japonica*.

Table 1 List of environmental variables

No	Category	Variable	Type	Use	Source
1	Terrain	Elevation	Continuous	O	NGII_DEM (2024)
2		Slope	Continuous	O	
3		Aspect	Continuous	O	
4	Vegetation index	NDVI	Continuous	O	KIGAM_Landsat based NDVI (2019)
5		Land cover	Category		MOE/EGIS_National Land Cover Map (2025)
6		Forest type	Category		KFS/FSIS_Forest Type Map (2025)
7		Forest type of physiognomy	Category		KFS/FSIS_Derived from Forest Type Map (2025)
8	Hydrological	Distance from streams	Continuous	O	VWorld/Open Market_Actual width Rivers (2025)
9		TWI (Topographic Wetness Index)	Continuous		KIGAM_TWI (2019)

NGII: National Geographic Information Institute; KIGAM: Korea Institute of Geoscience and Mineral Resources; MOE: Ministry of Environment; EGIS: Environmental Geographic Information Service; KFS: Korea Forest Service; FSIS: Forest Spatial Information Service; Vworld: National Spatial Information Platform; NDVI: Normalized Difference Vegetation Index.

Results

Host plant survey and diversity analysis

Through this study, *K. japonica* was found to parasitize a total of 26 host plant species, including 15 newly recorded hosts in addition to the 11 species previously reported in the literature. The identified hosts were classified into 11 families and 18 genera (Table 2), with particularly high representation in the Oleaceae (5 species, 20%), Lauraceae (5 species, 20%), and Theaceae (4 species, 16%). The host composition was dominated by evergreen broad-leaved species, reflecting a concentration of potential hosts within these families.

Analysis of growth forms revealed that 69.2% of the host species were evergreen and 100% were broad-leaved. No parasitism was recorded on conifers, while parasitism occurred predominantly on evergreen broad-leaved species, with some occurrences on deciduous broad-leaved species as well. Among the 98 *K. japonica* individuals recorded during field surveys, *Eurya japonica* accounted for the highest proportion with 47 individuals (47.96%), followed by *Camellia japonica* with 19 individuals (19.39%). Together, these two species comprised approximately two-thirds of all observed cases. Other evergreen broad-leaved species, including *Cleyera japonica*, *Distylium racemosum*, and *Ligustrum japonicum*, also supported multiple parasitic individuals and were identified as major host groups (Fig. 4).

Quantitative assessment of host diversity revealed a Shannon diversity index (H′) of 1.867, corresponding to approximately 66% of the theoretical maximum (Hmax = 2.833). According to ecological benchmarks, this value falls within the typical range of 1.5–3.5 observed in plant communities and is therefore considered to represent a moderate level of diversity (Magurran 2004). Pielou's evenness index (J′) was calculated as 0.659, which also falls within the range indicating moderate evenness (Kent 2012). This suggests that while *K. japonica* parasitizes a variety of host species, it shows a distinct preference for certain hosts. Furthermore, a Chi-square goodness-of-fit test indicated a highly significant deviation from uniform host usage ($\chi^2 = 364.12$, df = 16, $p < 0.001$), confirming that parasitism was not randomly distributed but strongly skewed toward specific host species such as *E. japonica* and *C. japonica* (Gotelli and Ellison 2013).

Potential habitat distribution modeling

The predictive performance of the MaxEnt model yielded an AUC value of 0.886 (± 0.035), which falls within the

Table 2 List of host plant species

No	Family	Scientific name	Field survey	Specimen	Literature source	Newly
1	Betulaceae	*Carpinus tschonoskii* Maxim.	o			o
2	Celastraceae	*Euonymus alatus* (Thunb.) Siebold	o			o
3		*Euonymus hamiltonianus* Wall.	o			o
4		*Euonymus japonicus* Thunb.			o2)3)4)5)6)	
5	Ericaceae	*Rhododendron mucronulatum* Turcz.		o		o
6		*Vaccinium bracteatum* Thunb.			o2)5)	
7	Hamamelidaceae	*Distylium racemosum* Siebold & Zucc.	o			o
8	Aquifoliaceae	*Ilex crenata* Thunb.			o1)	
9		*Ilex integra* Thunb.	o		o1)3)4)6)7)	
10	Lauraceae	*Lindera erythrocarpa* Makino		o		o
11		*Litsea coreana* H.Lév.	o			o
12		*Machilus thunbergii* Siebold & Zucc.		o		o
13		*Neolitsea aciculata* (Blume) Koidz.	o			o
14		*Neolitsea sericea* (Blume) Koidz.	o			o
15	Myrtaceae	*Callistemon speciosus* (Sims) Sweet	o			o
16	Oleaceae	*Ligustrum japonicum* Thunb.	o	o	o1)4)6)	
17		*Ligustrum lucidum* W.T.Aiton			o7)	
18		*Ligustrum obtusifolium* Siebold & Zucc.		o		o
19		*Ligustrum ovalifolium* Hassk.	o	o		o
20		*Osmanthus × fortunei* Carrière			o1)	
21	Rubiaceae	*Adina rubella* Hance	o			o
22	Styracaceae	*Styrax japonicus* Siebold & Zucc.	o	o		o
23	Theaceae	*Camellia japonica* L.	o	o	o1)2)3)4)5)6)7)	
24		*Cleyera japonica* Thunb.	o	o	o7)	
25		*Eurya emarginata* (Thunb.) Makino	o		o1)	
26		*Eurya japonica* Thunb.	o	o	o1)2)3)4)5)6)	

1) Korea National Arboretum. National Species Information System (https://www.nature.go.kr/), 2) National Institute of Biological Resources. Biodiversity of the Korean Peninsula (https://species.nibr.go.kr/), 3) Korea National Park Service. Species Information System (https://www.knps.or.kr/), 4) Lee (1996). Illustrated Flora of Korea, 5) Lee (2014). Flora of Korea, 6) Moon & Lee (2014). Diseases and Insect Pecstsof Woody Plants, 7) Choi et al. (2009). Anatomy of the Korean mistletoe and their haustorialfeatures in host plants.

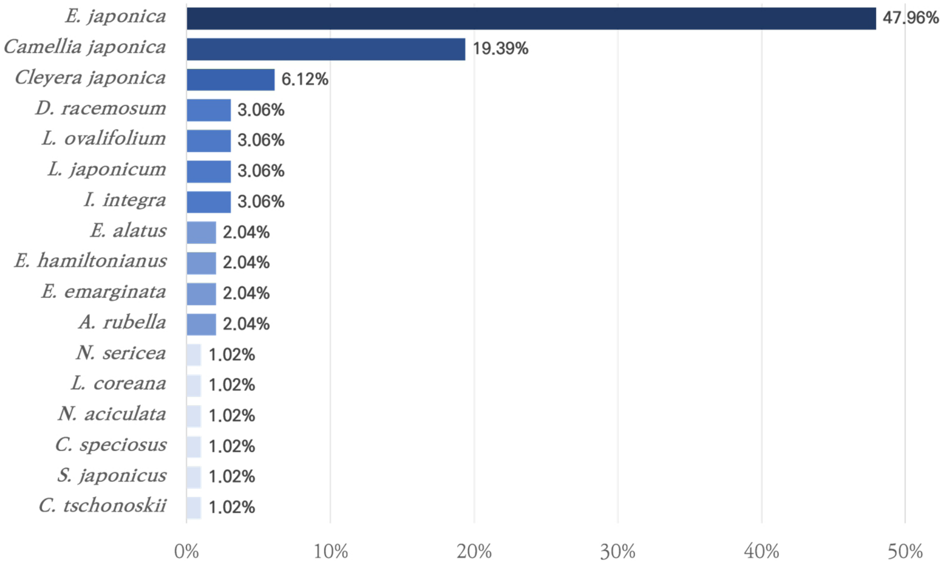


Fig. 4 Field survey-based occurrence rate of *Korthalsella japonica*.

Table 3 Contribution of environmental variables to habitat suitability

Category	Variable	Percent contribution (%)	Permutation importance (%)
Terrain	Elevation	14.6	23.8
	Slope	23.0	36.5
	Aspect	9.5	12.2
Vegetation index	NDVI	10.5	13.0
Hydrological	Distance from streams	42.4	14.5

NDVI: Normalized Difference Vegetation Index.

acceptable discrimination range, as AUC values between 0.5 and 0.7 indicate poor discriminatory ability and those between 0.7 and 0.9 are considered acceptable (Pearce and Ferrier 2000). Based on permutation importance, the relative contributions of the environmental variables were as follows: slope (36.5%) had the highest contribution, followed by elevation (23.8%), distance from streams (14.5%), NDVI (13.0%), and aspect (12.2%) (Table 3). Together, slope and elevation accounted for more than 60% of the total explanatory power, highlighting the strong influence of topography on the potential distribution of *K. japonica*.

Spatial predictions showed that suitable habitats were primarily concentrated in the lower mid-mountainous regions of Jeju Island, particularly in gently sloping areas near streams (Fig. 5). The predicted habitat suitability map closely matched observed distribution records, with 81.5% of the observed occurrence points falling within the predicted suitable area (Fig. 6).

Further analysis of individual environmental variables revealed clear patterns. For slope, *K. japonica* occurrences were most frequently observed on gentle terrains between 0–10°, with steep slopes rarely used (Fig. 7A). Elevation analysis indicated a concentration between 100–400 m, with decreasing frequency at higher elevations (Fig. 7B). Regarding hydrological conditions, the highest frequency of occurrence was within 0–300 m from streams, with a sharp decline beyond that distance (Fig. 7C). Aspect analysis showed a preference for south- to southwest-facing slopes (Fig. 7D), which are associated with greater light availability important for photosynthesis (Ruban 2009), and concentrated solar radiation in the afternoon that can modify microclimatic conditions (Chung et al. 2007; Desta et al. 2004). For NDVI, the highest frequency was observed in the range of 0.8–0.9 (Fig. 7E), reflecting vigorous vegetation and higher chlorophyll content (Eo et al. 2021; Rouse et al. 1974). Collectively, these results indicate that suitable habitats for *K. japonica* are associated with stable hydrological conditions, dense vegetation, and favorable topographic settings.

A cross-analysis of the predicted binary habitat suitability map with forest type data revealed that broad-leaved forests accounted for the largest proportion of predicted suitable habitat, covering 25,280 ha (46.5%) (Table 4, Fig. 8). In addition, coniferous plantations of *Pinus thunbergii* Parl. and *Cryptomeria japonica* (Thunb. Ex L. f.) D. Don frequently contained understory layers of evergreen broad-leaved species, including *Machilus thunbergii* and *E. japonica*, which are known primary hosts of *K. japonica* (Hong and You 2018). This suggests that potential host species may also be available in coniferous plantations, extending the range of suitable habitats beyond natural broad-leaved forests.

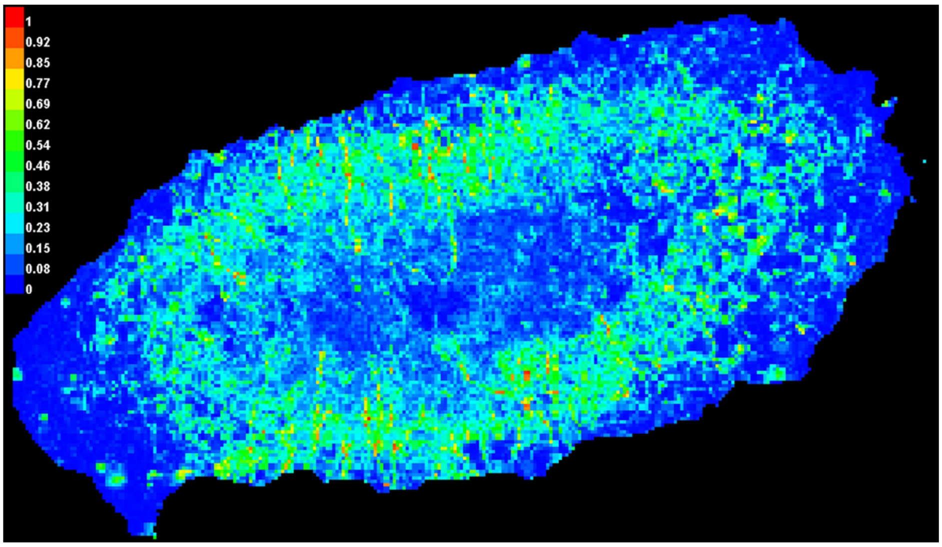


Fig. 5 Habitat suitability prediction map. Continuous habitat suitability (MaxEnt, logistic 0–1). Warmer colors indicate higher suitability; the color bar was enlarged for clarity. AUC = 0.886. AUC: area under the ROC curve.

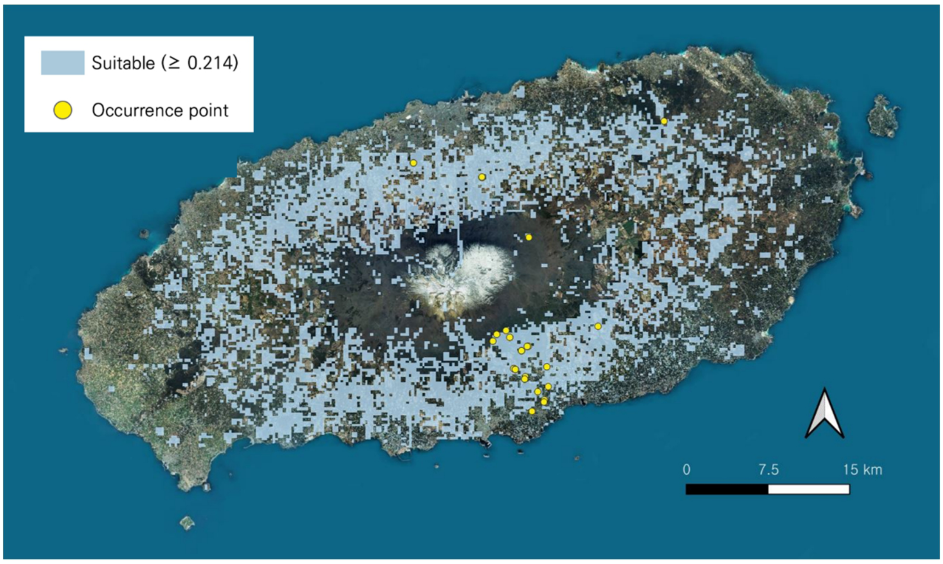


Fig. 6 Binary habitat suitability map. Binary map showing only suitable habitat using the 10th percentile training presence threshold (≥ 0.214). Areas < 0.214 are omitted for clarity.

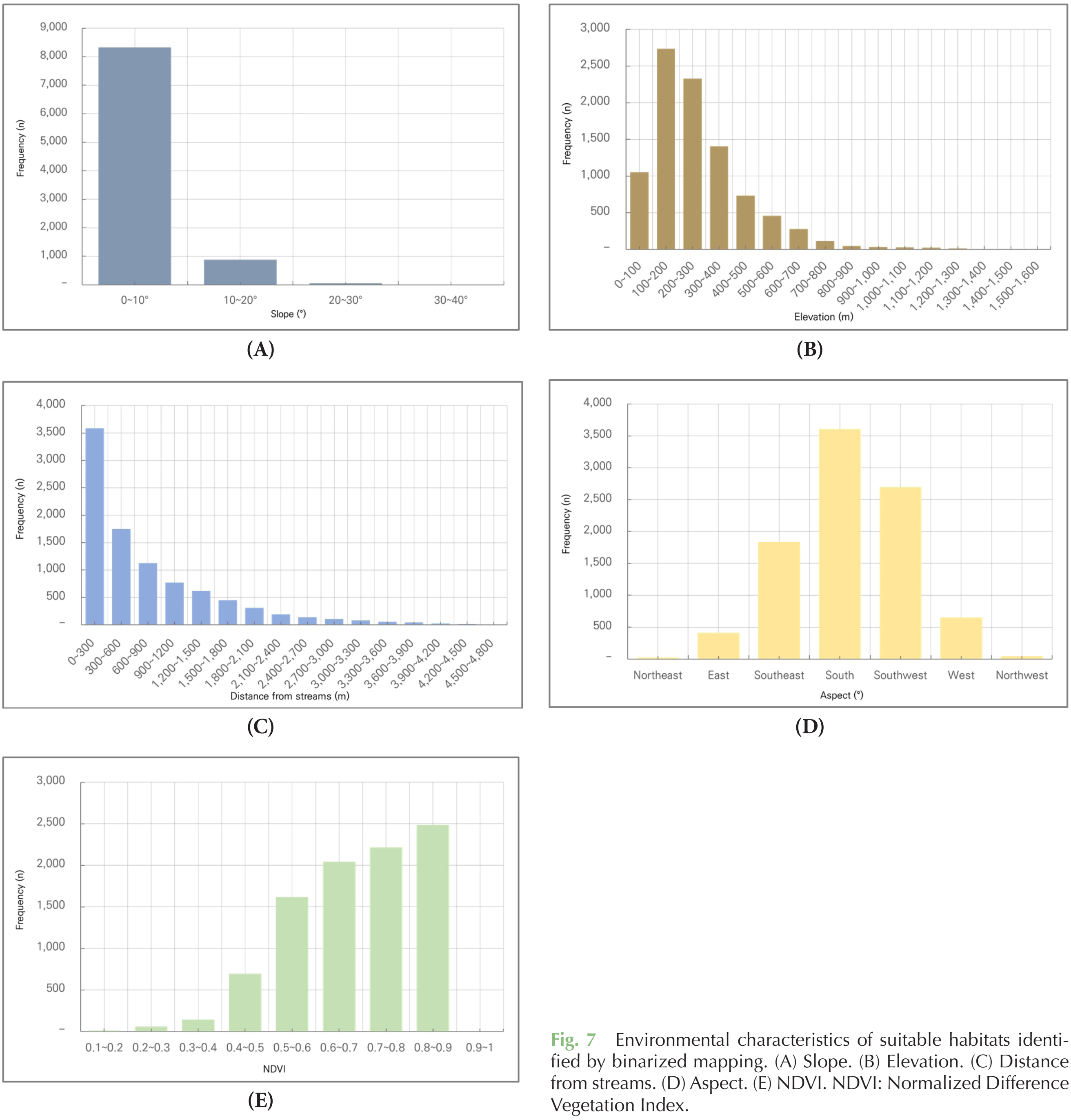
Discussion

This study confirmed that *K. japonica* parasitizes 26 host species belonging to 18 genera and 11 families, exhibiting moderate host diversity and evenness. Despite this diversity, parasitism was particularly concentrated on dominant evergreen broad-leaved species—especially *E. japonica* and *C. japonica*. These findings suggest that *K. japonica* shows intermediate host specificity, relying on a range of potential hosts but exhibiting strong preferences toward particular taxa.

Comparable host-use patterns have been reported for other mistletoe species. Members of the genus *Viscum* often display broad host spectra at the species level yet maintain high frequencies of parasitism within specific phylogenetic groups (Maul et al. 2019). Likewise, *T. yadoriki* demonstrates a wide host range, while disproportionately exploiting certain families such as Lauraceae and Theaceae (Lee et al. 2024). In this context, the host selectivity of *K. japonica* aligns with a general pattern among mistletoes—broad potential host ranges coupled with ecological or physiological preferences for particular lineages. Such preferences may be driven not only by host availability but also by compatibility of xylem structure, bark characteristics, and spatial proximity of suitable hosts.

The strong association of *K. japonica* with evergreen broad-leaved trees on Jeju Island reflects both ecological and biogeographical factors. Evergreen species such as *E. japonica* and *C. japonica* dominate warm-temperate forests and provide stable resources throughout the year, which likely enhance the establishment and survival of mistletoe individuals. Moreover, the dense and aggregated structure of evergreen stands creates microhabitats with moderated temperature and humidity, favoring mistletoe attachment and growth. These results suggest that the spatial aggregation and environmental stability of evergreen forests jointly facilitate the persistence of *K. japonica* populations.

Habitat suitability modeling further supported these



(A)

(B)

(C)

(D)

(E)

Fig. 7 Environmental characteristics of suitable habitats identified by binarized mapping. (A) Slope. (B) Elevation. (C) Distance from streams. (D) Aspect. (E) NDVI. NDVI: Normalized Difference Vegetation Index.

Table 4 Area proportions of forest types within predicted suitable habitats

Type	Area (ha)	Percent (%)
Unstocked forest land / Non-forest	8,071	14.8
Bamboo forest	47	0.1
Coniferous forest	15,154	27.9
Mixed forest	5,829	10.7
Broad-leaved forest	25,280	46.5

ecological interpretations. Topographic factors, particularly slope and elevation, contributed more than 60% of the model's explanatory power, highlighting their importance in shaping the distribution of *K. japonica*. Secondary variables, including distance to streams, NDVI, and aspect, refined the spatial differentiation of suitable habitats and underscored the significance of hydrological stability, vegetation vigor, and microclimatic conditions. The predicted high-suitability areas correspond closely to the distribution of evergreen forests across Jeju, suggesting that *K. japonica* depends on both host availability and suitable environmental settings provided by these forests.

The binary suitability map showed an 81.5% match between predicted and observed occurrences, confirming the reliability of the model. Notably, some predicted suitable zones overlapped with coniferous plantations and second-

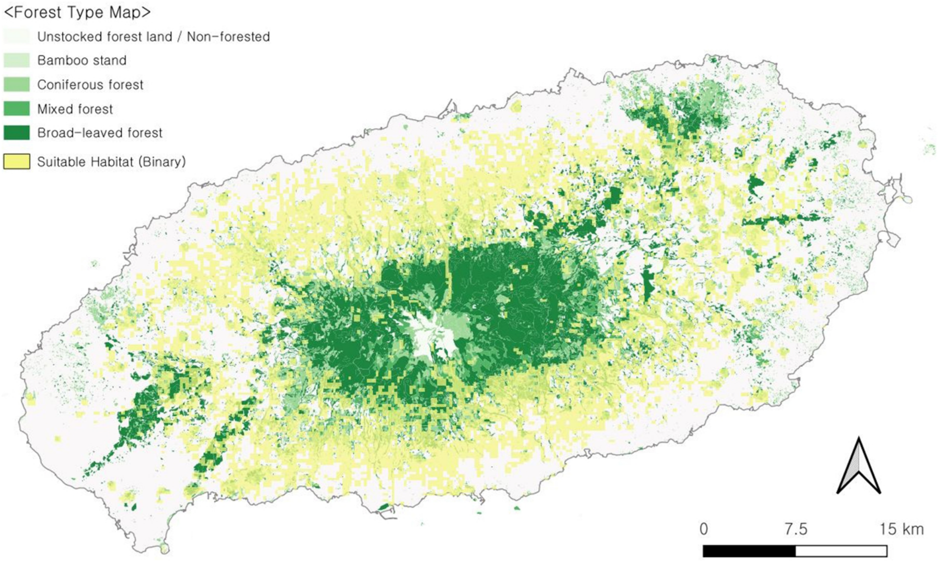


Fig. 8 Spatial overlay of forest types and predicted habitat suitability.

ary mixed forests. This overlap implies that potential habitats for *K. japonica* may expand beyond natural evergreen forests, provided that appropriate host species such as *M. thunbergii* and *E. japonica* occur within the understory. These findings indicate that secondary or planted forests could serve as supplementary habitats, potentially supporting mistletoe colonization and persistence under appropriate ecological conditions.

The ecological role of *K. japonica* extends beyond its parasitic relationship with host plants. Although mistletoes are generally regarded as parasitic species with negative impacts on host vitality, many studies have emphasized their broader ecological functions. Mistletoes can act as facilitators of biodiversity by providing food, shelter, and nesting materials for various organisms, including birds, mammals, and insects (Press and Phoenix 2005; Watson 2001; Watson and Herring 2012). Through these functions, they contribute to food-web connectivity, nutrient cycling, and habitat heterogeneity within forest ecosystems. In warm-temperate evergreen forests such as those in Jeju, mistletoes may thus function as keystone resources that support community-level diversity and ecological resilience.

From a physiological perspective, *K. japonica* is a hemiparasitic species capable of limited photosynthesis but dependent on its host for water and mineral nutrients (Del Rio et al. 1996; Muche et al. 2022). Its seed dispersal is primarily mediated by birds, indicating that the establishment and spread of *K. japonica* depend on both host distribution and the behavior of avian dispersers (Luo et al. 2016; Okubamichael et al. 2017). Consequently, mistletoe distribution patterns can be interpreted as outcomes of coupled host and bird ecological preferences. Areas supporting high densities of both suitable hosts and bird dispersers are therefore expected to provide optimal conditions for *K. japonica* persistence.

Collectively, these findings demonstrate that *K. japonica*'s ecological traits are governed by the interplay between biotic and abiotic factors. The spatial structure of dominant evergreen hosts, together with hydrological and topographic gradients, acts as a primary determinant of its distribution. Understanding this host–environment coupling is essential not only for elucidating mistletoe ecology but also for interpreting plant–plant and plant–animal interactions within evergreen forest ecosystems.

Finally, while this study provides comprehensive empirical insights into the host diversity and habitat preferences of *K. japonica*, several limitations should be acknowledged. The research was geographically confined to Jeju Island and based on a relatively small number of field sites, which may have influenced estimates of diversity and model stability. Furthermore, the uneven distribution of parasitic individuals among host species could partially bias diversity indices. Future work should expand the spatial and temporal scope of sampling, incorporate genetic or physiological analyses of host compatibility, and apply mechanistic or dynamic modeling frameworks to better capture host–parasite feedbacks under changing environmental conditions. Such integrative approaches will deepen the ecological understanding of *K. japonica* and its host interactions.

Conclusions

This study provides an integrated ecological assessment of *K. japonica*, revealing moderate host specificity and a strong affinity for dominant warm-temperate evergreen broad-leaved species. Habitat suitability modeling demonstrated a close match between predicted and observed distributions, indicating that the species' occurrence is shaped by both host availability and environmental conditions, particularly topographic, hydrological, and vegetative factors. Collectively, these findings highlight the combined influence of biotic and abiotic drivers in determining the distribution of *K. japonica* and underscore its ecological dependence on evergreen forest ecosystems.

The results also provide practical implications for forest management and biodiversity conservation, particularly in prioritizing host tree preservation and habitat restoration in areas where the species is concentrated.

Supplementary Information

Supplementary information accompanies this paper at https://doi.org/10.5141/jee.25.076.

Table S1. List of examined specimens of *Korthalsella japonica* (this study)

Abbreviations

WTSFRC: Warm Temperate and Subtropical Forest Research Center
AUC: Area under the ROC curve
NDVI: Normalized Difference Vegetation Index

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Authors' contributions

JSL conceived the ideas, conducted the data collection and analysis, and wrote the manuscript. EYY conducted the field study, managed the research activities, and reviewed the manuscript. KSL provided the research resources, contributed to the methodology, managed the research activities, and reviewed the manuscript. All authors read and approved the final manuscript.

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Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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