

## Short Communication

### Conservation status of the endemic fern *Mankyua chejuense* (Ophioglossaceae) on Cheju Island, Republic of Korea

Chul Hwan Kim

**Abstract** *Mankyua chejuense*, a fern endemic to Cheju Island, Republic of Korea, which lies 120 km south of the Korean Peninsula, appears to be restricted to five extant subpopulations in the north-east of the Island, with a total population of c. 1,300 individuals. Major threats to the existence of the species include shifting cultivation, plantation, overuse of basaltic rocks that are part of the species' microhabitat, farming and pasturage, and the construction of roads and golf courses in lowland areas. The information currently available for the species indicates that it should be categorized as Critically

Endangered on the IUCN Red List. For conservation of the species it needs to be included on the national threatened species list, and its habitat designated as an ecological reserve. Intensive surveys are required in order to establish whether there are any other extant subpopulations of the species, and the presently known subpopulations require long-term monitoring and continuous protection.

**Keywords** Cheju Island, Critically Endangered, endemic, fern, *Mankyua chejuense*, Ophioglossaceae, Republic of Korea.

The 1,824 km<sup>2</sup> Cheju Island is located 140 km south of the Korean Peninsula. It is of volcanic origin and the highest peak, Halla Mountain, rises to an altitude of 1,950 m. The island has three main landscape types: lowland areas near the coast, gently inclined hillsides at altitudes of 300–800 m, and steep mountainous areas above 800 m. Cheju Island has a greater species richness than any region of the Korean Peninsula (Kim, 2000; Kim & Lee, 2001). Although the island is only 0.83% of the total land area of the Peninsula, it contains c. 1,800 vascular plant taxa (Kim, 1992), i.e. 45% of the total flora of the Peninsula. Three vegetation types are recognized: subtropical evergreen forests below altitudes of 600 m, dominated by *Quercus acuta*, *Q. myrsinaefolia* and *Castanopsis cuspidata*, cool-temperate deciduous forests over 600–1,400 m, dominated by *Carpinus laxiflora*, *C. tschonoskii*, *Q. x grosseserrata*, *Q. serrata* and *Pinus densiflora*, and subalpine coniferous forests above 1,400 m, dominated by *Abies koreana* and *Juniperus chinensis* var. *sargentii* (Yim *et al.*, 1990).

Recently, Sun *et al.* (2001) described *Mankyua chejuense*, a monotypic fern genus belonging to the family Ophioglossaceae, from Cheju Island. The species was recorded over a relatively restricted area, with a low

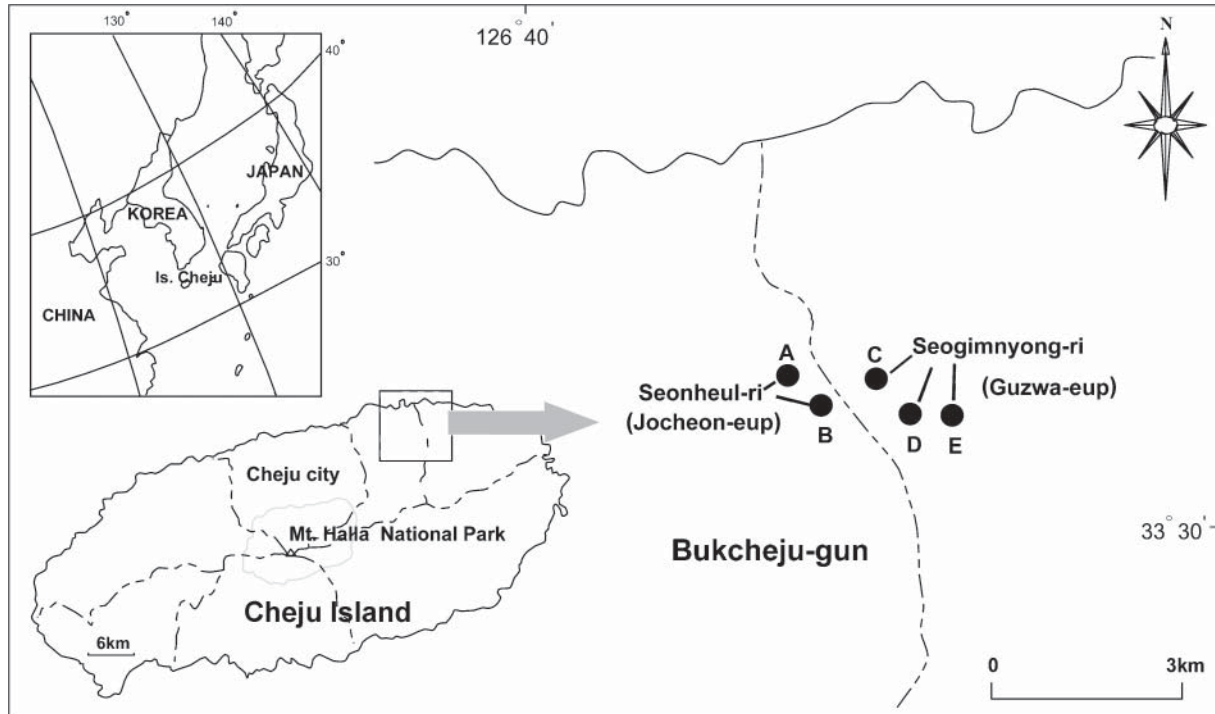
number of individuals. In this paper I report an approximate total count of *M. chejuense*, examine its conservation status, identify factors threatening the species' survival, and propose an IUCN Red List status for the species.

*M. chejuense* is a small perennial fern that remains green in winter; it grows to a height of 10–12 cm and has horizontally creeping subterranean rhizomes. It grows in lowland forests dominated by evergreen tree species. *Mankyua* has a unique combination of features that clearly separate it from the other genera of the family Ophioglossaceae (*Helminthostachys*, *Ophioglossum* and *Botrychium*) by the shape and venation pattern of its trophophore blades, morphology of its sporophores, and the nature of its rhizomes (Sun *et al.*, 2001). *M. chejuense* propagates vegetatively by proliferation of the roots. New shoots or buds are formed from recent derivatives of the root apices. The species generally has a clumped distribution, and the clumps are probably formed by vegetative propagation of the roots; individuals close to each other may belong to a single clone. This kind of vegetative propagation also occurs in the genus *Ophioglossum*. The gametophytic phase of *M. chejuense* has not been reported, but the species is expected to have a sexual phase during its life cycle.

In surveys for *M. chejuense* carried out in 2001 and 2002 I was able to locate only five subpopulations, in north-eastern Cheju Island. A count of each subpopulation indicated that the total population is c. 1,300 individuals, with subpopulations varying in size from 10 to 900. Subpopulations are located c. 15–20 km east of Cheju

Chul Hwan Kim Faculty of Biological Sciences, Chonbuk National University, Chonju, Chonbuk 561-756, Republic of Korea. E-mail plantaxa@hanmail.net

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**Fig. 1** The location of the five subpopulations (A–E) of *M. chejuense* on Cheju Island, Korea. (A) 10.5 × 13 m in area with 40 individuals; (B) 16.6 × 17 m in area with 300 individuals; (C) 15 × 15 m in area with 50 individuals; (D) 10 × 10 m in area with 10 individuals; (E) 17.5 × 30 m in area with 900 individuals.

city, 4 km from the coast (Fig. 1). All five subpopulations have a clumped distribution and each clump is usually composed of 10–30 individual plants with as little as 5 cm between individuals. The areas where the species occur are generally flat, with inclinations of <15 degrees, at altitudes of 100–120 m. The sites of all subpopulations are *c.* 1 m lower in elevation than the surrounding areas, and the ground surface consists of basaltic rocks 20–40 cm in diameter and dark brownish sands with poor soil development. Water passes through this soil relatively quickly, and it is thus usually dry, except during the summer rainy season. The average temperature and rainfall at the nearest meteorological station, Cheju city, is 15.1°C and 1,200 mm, respectively (Yim *et al.*, 1990).

On Cheju Island there used to be many lowland areas that were relatively similar, topographically and phytosociologically, to the present known habitat of *M. chejuense*. However, these areas, particularly below 800 m, have been markedly modified by humans since the 1950s. Major interventions have included shifting cultivation, plantations, overuse through quarrying of basalt, farming and pasturage. It is possible that there may formerly have been a greater number of populations or subpopulations of *M. chejuense*, but that these were extirpated by these various activities. The former and

present major threats to the survival of *M. chejuense* are as follows:

- 1) Shifting cultivation was formerly common in the lowland areas (Yim *et al.*, 1990) and the remaining natural forests where *M. chejuense* occurs are found only in areas that escaped cultivation because of their unfavourable landform for farming (Yim *et al.*, 1990). The present area of cultivated land on Cheju Island, including orchards and pastures, is mostly below 400 m altitude and covers 681 km<sup>2</sup>, 37.5% of the total area of the island (Yim *et al.*, 1990). Any expansion of cultivated lands into areas presently regarded as marginal for agriculture will be a threat to the survival of *M. chejuense*.
- 2) In the past the trees *Cryptomeria japonica* and *Chamaecyparis obtusa* were planted in lowland areas for both their wood and as windbreaks. The areas used for this purpose are similar topographically and phytosociologically to the present habitat of *M. chejuense*, and thus tree planting could have caused the extirpation of previously unknown populations of the species.
- 3) Extensive use has been made, for walls and ornamental purposes, of the basaltic stones typical of the habitat of *M. chejuense*. These stones, typically with diameters of 20–40 cm, are a component of the

microhabitat of *M. chejuense*, and their overuse could have had a negative impact on the species.

- 4) The number of tourists visiting the island has increased over the last 30 years, and there has consequently been an expansion of the road network, especially in the coastal lowlands, where seven golf courses have been built within the last 20 years. In 1998, before the discovery of *M. chejuense*, an attempt was made to build a resort facility, including a golf course, in the area that included the presently known habitat of the species. The plans did not go through due to the bankruptcy of the entrepreneur and strong objections from environmental organizations on the Island. If the golf course had been constructed, the species would most likely have become extinct prior to its discovery.
- 5) Although *M. chejuense* is not particularly attractive from an ornamental point of view, it has the novelty of being rare, and has been seen on sale in the flower markets of Seoul since 2002 (pers. obs.).

In summary, *M. chejuense* is regarded as a threatened and important species because: (1) it is endemic to Cheju Island, with only five subpopulations currently known that comprise a total of c. 1,300 individuals found only in a restricted area, (2) the geomorphology and phytosociology of the areas where the species grows has unique features compared to the surrounding areas, (3) the area from which the species is known is relatively restricted in extent (c. 3 km<sup>2</sup>) and the typical habitat of the species has been markedly reduced by past human influence, and (4) there is evidence that the species is being collected and sold for its value as a rarity. Taken together this information suggests that *M. chejuense* should be categorized as Critically Endangered on the IUCN Red List (IUCN, 2003), based on criteria B2a+b (IUCN, 2001), i.e. with an area of occupancy of <10 km<sup>2</sup> (B2), severely fragmented (a), and with a continuing projected decline (b) in extent of habitat.

For a small restricted population the threat of extinction is high, and a conservation programme for *M. chejuense* is urgently required. A total of 58 wild plant taxa in danger of extinction, and several ecological reserves, are currently protected by the Natural Environment Preservation Act of the Republic of Korea (Oh & Hyun, 1998). For its protection by law from any kind of interference, including commercial or personal collection, *M. chejuense* needs to be included in the national threatened species list. Simultaneously, the species' currently known habitat, covering c. 15 km<sup>2</sup>, with the

inclusion of the surrounding evergreen forest of the *Quercus glauca-Camellia japonica* community, needs to be designated as an ecological reserve to prohibit any further disturbances. A conservation programme for the species needs to include intensive botanical surveys of the lowland areas of Cheju Island in order to determine whether there are any other extant populations of the species, and the presently known subpopulations require long-term monitoring and continuous protection.

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### Biological sketch

Chul Hwan Kim has studied the systematics of *Eleutherococcus* and related genera of the plant family Araliaceae, and his research interests are currently focused on the development of conservation strategies for threatened endemic plant species on two volcanic islands of the Republic of Korea, Cheju Island and Ullung Island.